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PDSS/IMC REQUIREMENTS AND FUNCTIONAL SPECIFICATIONS

1 JUNE 1983

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PREFACE

This document contains the system (software and hardware) requirements for the Payload Development Support System (PDSS)/Image Motion Compensator (IMC). The PDSS/IMC is to be used for checkout and verification of the IMC flight hardware and software by NASA/MSFC.

This document was prepared for the Information and Electronic Systems Laboratory of the Marshall Space Flight Center under NASA contract NAS8-33825.

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ACRONYMNS

AI	Analog Input
AO	Analog Output
ASTROS	Advanced Star/Target Reference Optical Sensor
CCD	Charged Coupled Device
CDMS	Command and Data Management Subsystem
CIS	Computer Interface Simulation
DEP	Dedicated Experiment Processor
DI	Discrete Input
DO	Discrete Output
DRIRU	Dry Rotor Inertial Reference Unit
ECAS	Experiment Computer Application Software
ECIO	Experiment Computer Input/Output
ECOS	Experiment Computer Operating System
ESA	European Space Agency
GMT	Greenwich Mean Time
GSE	Ground Support Equipment
HRM	High Rate Multiplexor
HUT	Hopkins Ultraviolet Telescope
IIA	Instrument Interface Agreement
IMC	Image Motion Compensator
IMCE	Image Motion Compensation Electronics
IMCS	Image Motion Compensation Subsystem
IPS	Instrument Pointing System
LAM	Look At Me
NASA	National Aeronautics and Space Administration
PCC	Programmable Crate Controller
PCM	Pulse Code Modulated
PDSS	Payload Development Support System
POCC	Payload Operations Control Center
QT	Qualification Test
RAU	Remote Acquisition Unit
RAUI	Remote Access Unit Interface
RAUS	Remote Access Unit Simulator
RIUI	Remote Interface Unit Interface
SEID	Spacelab Experiment Interface Device
SI	Serial Input
SL	Space Lab
SO	Serial Output
SRR	Software Requirements Review
SWCDR	Software Critical Design Review
SWCI	Software Configuration Inspection
SWPDR	Software Preliminary Design Review
UV	Ultraviolet
UIT	Ultraviolet Imaging Telescope
UTC	User Time Clock
WUPPE	Wisconsin Ultraviolet Photopolarometry Experiment

1.0 INTRODUCTION

1.1 SCOPE

This document contains the system (software and hardware) requirements for the Payload Development Support System (PDSS)/Image Motion Compensator (IMC). The PDSS/IMC system will provide the capability for performing Image Motion Compensator Electronics (IMCE) flight software test, checkout, and verification and will provide the capability for monitoring the IMC flight computer system during qualification testing for fault detection and fault isolation.

NOTE: This document establishes the requirements for the PDSS/IMC; however, where possible, hardware and software details have been included. Implementation of PDSS/IMC will meet all requirements levied by this document. Implementations that differ in details are acceptable when requirements are not affected and the implementation improves system performance or operation.

The requirements contained in this document encompass the PDSS Function, IMCE Qualification Testing, IMCE Computer Interface Simulation, and logged data Post Processing.

1.2 PDSS/IMC CONFIGURATION CONTROL

The PDSS/IMC software will be verified and placed under Configuration Control before being used with IMCE.

PDSS/IMC will be maintained under Configuration Control in accordance with the PDSS Configuration Control Plan and Procedures (IR-AL-003). The PDSS/IMC configuration will be maintained to the same level as the PDSS hardware and software.

The PDSS/IMC Configuration Control items include:

- PDSS/IMC Requirements and Functional Document Specification (IR-AL-010)
- PDSS/IMC User's Guide (IR-AL-011)
- PDSS/IMC Test Plan & Procedures (IR-AL-012)
- PDSS/IMC Software Detailed Design Specifications (Software Listings)
- PDSS/IMC Software
- PDSS/IMC Hardware

Problems or discrepancies will be reported on Software Problem Report forms or Discrepancy Record forms as appropriate.

Delivery of the PDSS/IMC software package will be in accordance with the Software Release procedures and will be delivered through a Software Release Notice (SRN).

1.3 PDSS/IMC SOFTWARE MANAGEMENT AND DEVELOPMENT

PDSS/IMC Software will be developed in accordance with the principles outlined in the MSFC Software Management and Development Requirements document (MA-001-006-2H).

The PDSS/IMC development process will consist of eight (8) phases: Conceptual, Requirements, Design, Code and Debug, Verification, Validation, Systems Integration, and Operations and Maintenance. The following reviews will be conducted.

- Software Requirements Review (SRR)
- Software Preliminary Design Review (SWPDR)
- Software Critical Design Review (SWCDR)
- Software Configuration Inspection (SWCI)

The following documents will be generated:

- PDSS/IMC Requirements and Functional Specification Document
- PDSS/IMC Software Listing/Detail Design Specifications
- PDSS/IMC User's Guide
- PDSS/IMC Test Plan and Procedures

PDSS/IMC software will be designed, coded, tested and controlled in accordance with software standards and procedures outlined in the MA-001-006-2H document.

1.4 APPLICABLE DOCUMENTS

The following documents are applicable for the PDSS/IMC requirements.

[1] DRIRU-II Inertial Reference Unit Component Interface Specification for ASPS Gimbal System (AGS)
Contract No. NAS8-34367, Job No. 8088, CDRL Seq. No. 12
Teledyne Systems Company
February 1982

[2] ASPS Gimbal System Dry Rotor Inertial Reference Unit (DRIRU-II) Specification
MSFC-SPEC-565, Revision C
Appendix B
April 1981

[3] GSFC Specification Standard Telemetry and Command Components
(STACC) Remote Interface Unit (RIU) and Expander Unit (EU)
GSFC-S-714-11, Revision D
Goddard Space Flight Center
March 1979

[4] Technical Description for Advanced STAR/TARGET Reference Optical Sensor (ASTROS)
27 January 1983

[5] Detail Specification for an Advanced STAR/TARGET Reference Optical Sensor (ASTROS)
ES 513218
27 January 1983

[6] AST Real Time Telemetry Data Requirement Technical Memo
Jet Propulsion Laboratory
Harvey H. Horiuchi
10 May 1983

[7] PDSS User's Manual
IR-AL-001
Intermetrics, Inc.
30 April 1983

[8] PDSS Design Specification
IR-AL-006
Intermetrics, Inc.
30 April 1983

[9] SEID II Specification
IR-AL-007
Intermetrics, Inc.
1 April 1983

[10] PDSS Configuration Control Plan & Procedures
IR-AL-003
Intermetrics, Inc.
1 January 1983

[11] MSFC Software Management and Development Requirements
MA-001-006-2H
Revised
George C. Marshall Space Flight Center
January 1983

[12] Payload Development Support System Image Motion
Compensator Requirements
Marshall Space Flight Center
23 March 1983

[13] Image Motion Compensation System
Project Requirements Document Astro 1 Mission
MSFC-RQMT-906
Marshall Space Flight Center,
System Analysis and Integration Laboratory
March 1983

[14] Spacelab Payload Accommodations Handbook (SPAH)
SLP 2104, Appendix A
Spacelab Program Software Users Guide
MDC G68544
McDonnell Douglas Corporation

[15] Software Users Guide
Appendix B
DEP Users Guide
TM No. A90-ACIS-81182
Revision 3
McDonnell Douglas Corporation and IBM
1 March 1983

[16] RAUI Operation and Maintenance Manual
15M30124
George C. Marshall Space Flight Center
9 February 1983

[17] RAUS Operation and Maintenance Manual
15M30123
George C. Marshall Space Flight Center
9 February 1983

[18] IMCS Flight Software Requirements Specifications
MSFC-RQMT-TBD
MSFC, S&E
June 1983

2.0 PDSS/IMC SYSTEM DESCRIPTION

The PDSS/IMC is the Ground Support Equipment that provides the software and hardware interfaces to the Image Motion Compensation Electronics (IMCE) to allow the verification of the electronic hardware interfaces and the IMCE flight software. The PDSS/IMC is to be used for flight IMCE hardware development testing and flight software test, checkout, and verification.

The NASA Office of Space Science Mission "Astro 1" consists of three Ultraviolet (UV) telescopes clustered on the European developed Instrument Pointing Subsystem (IPS) mounted on a Spacelab pallet in the Space Shuttle Orbiter. The three UV telescopes are the Ultraviolet Imaging Telescope (UIT), the Hopkins Ultraviolet Telescope (HUT) and the Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE). The UIT is a direct imaging system that utilizes image intensifiers optically coupled to photographic film. Both the HUT and the WUPPE utilize spectrophotometers with single element apertures. All three instruments have the ability to view fainter stellar objects from Earth orbit than is possible from ground based telescopes. The IMC system being developed for the Astro 1 mission is different from the typical IMC in that one system serves two telescopes. Figure 2-1 shows the ASTRO-1 CDMS block diagram with the Image Motion Compensation System (IMCS).

As depicted in Figure 2-1, the IMCE subsystem interfaces with the following subsystems: (1) ASTROS-Star Tracker, (2) UIT Experiment, (3) WUPPE Experiment, (4) Spacelab Experiment Computer RAU, (5) DRIRU-II, and (6) HRM. The development and testing of the IMCE flight hardware interfaces and flight software will require Ground Support Equipment (GSE) that simulates the external environment to IMCE.

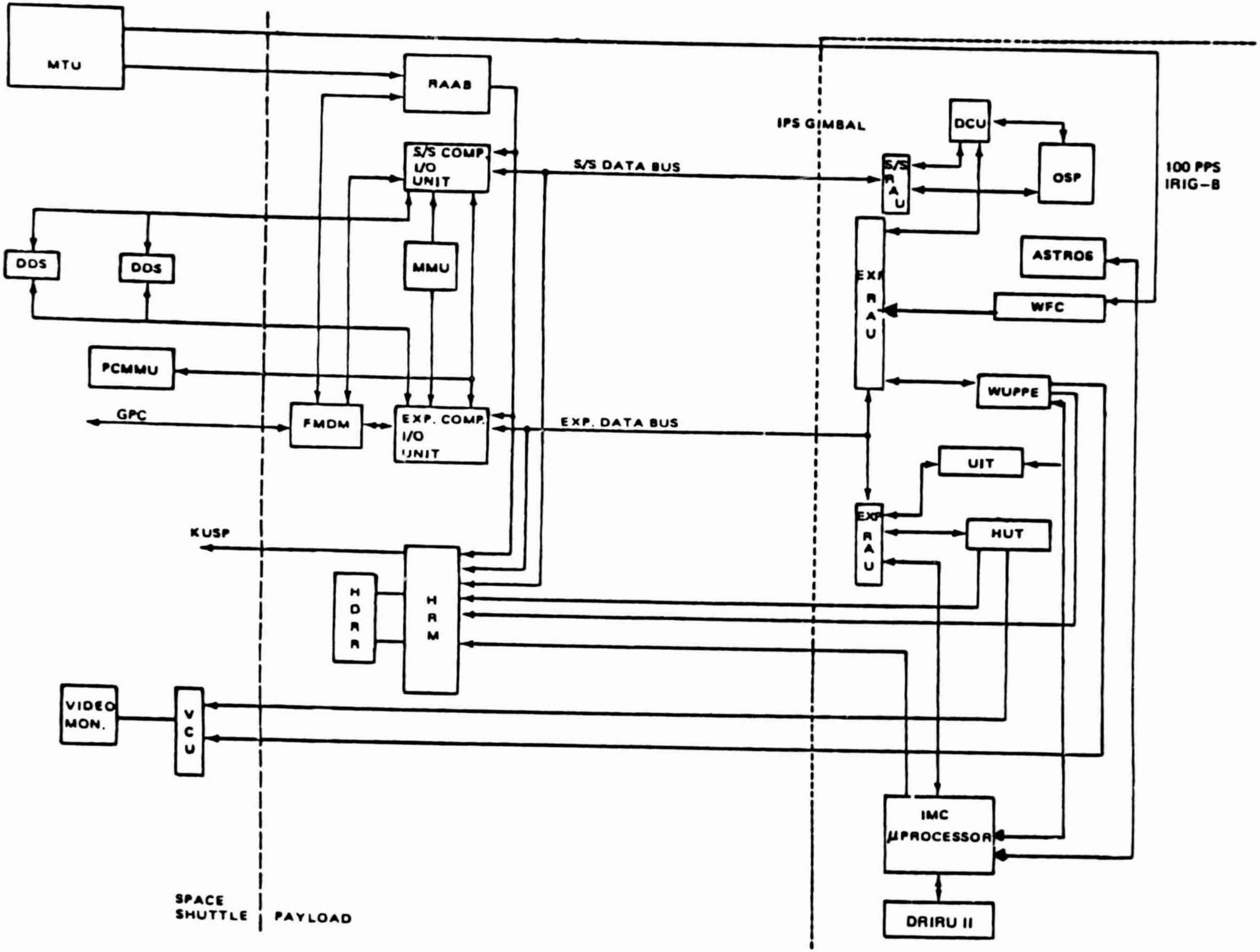

FIGURE 2-1: ASTRO-1 CDMS BLOCK DIAGRAM

2.1 PDSS/IMC HARDWARE DESCRIPTION

The IMCE Ground Support Equipment will be based on a Payload Development Support System (PDSS) with supporting special IMCE interface hardware. Figure 2-2 illustrates the IMCE GSE system that will be used for testing IMCE.

The PDSS/IMC GSE will be configured in a CAMAC configuration as illustrated in Figures 2-3 and 2-4.

The major PDSS/IMC components will include:

1. PDSS Host Processor
   - LSI 11/23 (MMU, FFP, 256K Bytes)
   - DSD 880 Disk Subsystem (30 megabytes + one floppy)
   - VT100-AA CRT
   - Special Boards (DLV11-J, DT2769, VRAQ/2K, DRV11)
   - Data South 180 Printer
   - Video Display Unit (B/W)

2. SEID
   - 4 Serial PCM Command and Data Channels
   - 64 Discrete Out (ON/OFF)
   - 128 Flexible Inputs
   - UTC
   - HRMI

3. CAMAC Crate
   - Crate Optima 850 (25 Slot)
   - MIK11/23L CAMAC Controller

4. CAMAC Cards
   - Type 3112-A1A/P1A Digital to Analog Modules
   - RAUI Interface Card
   - RIUI Interface Card
   - GYROS Interface Card

A brief description of these components will be provided in the following sections. Table 2-1 summarizes the interfaces for PDSS/IMC.

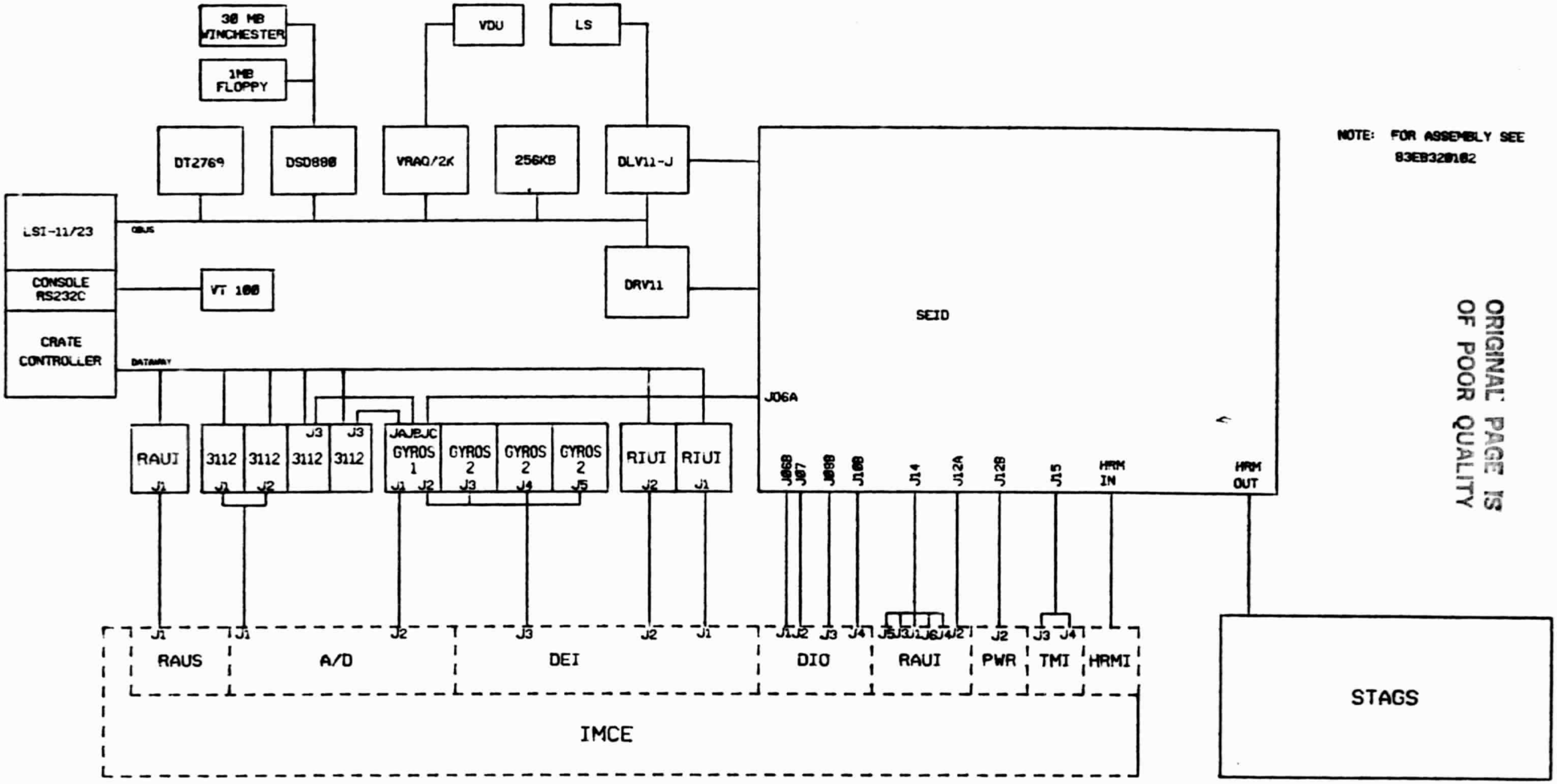

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FIGURE 2-2: PDSS/IMC GSE DIAGRAM

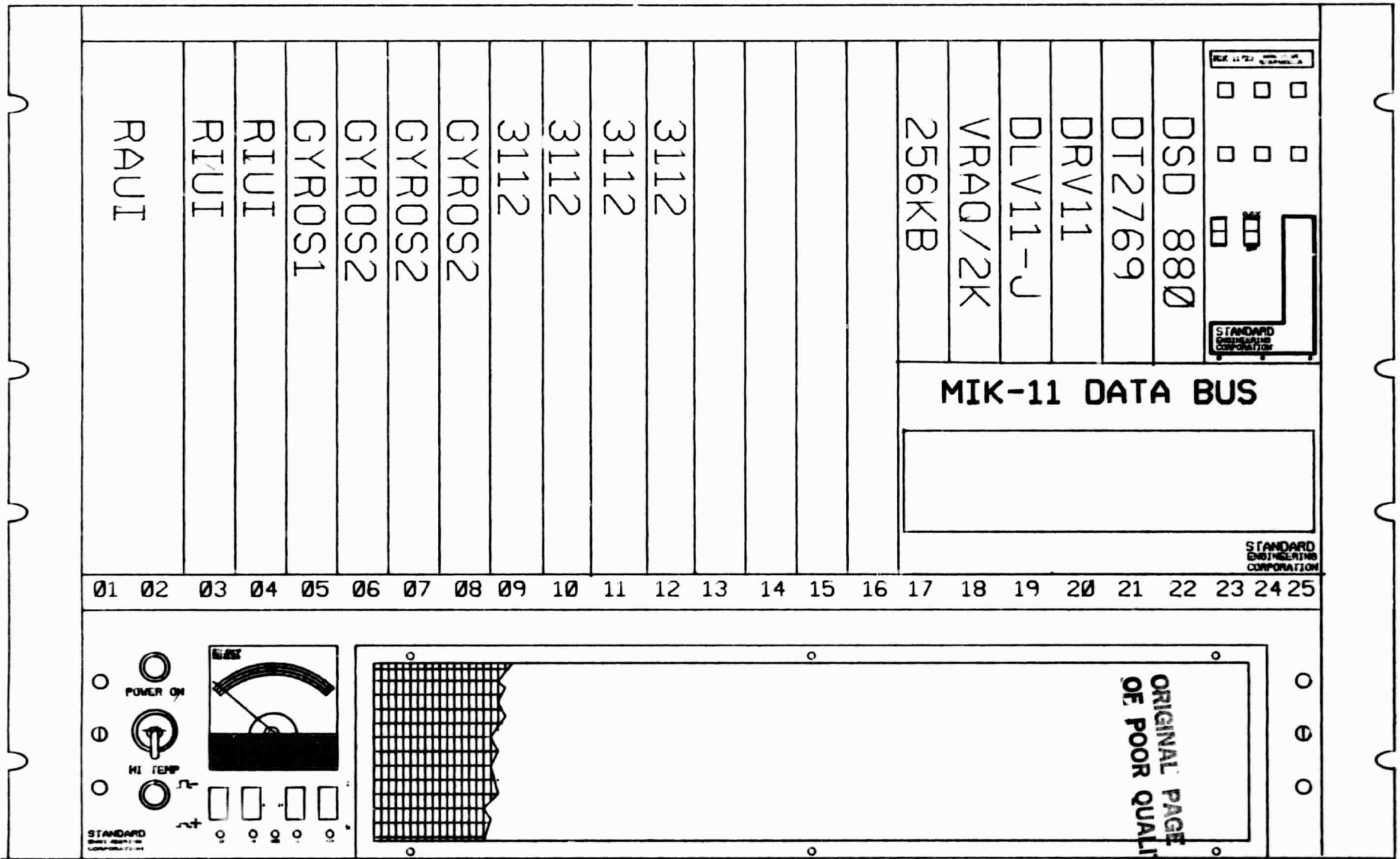

FIGURE 2-3: PDSS/IMC CAMAC CRATE

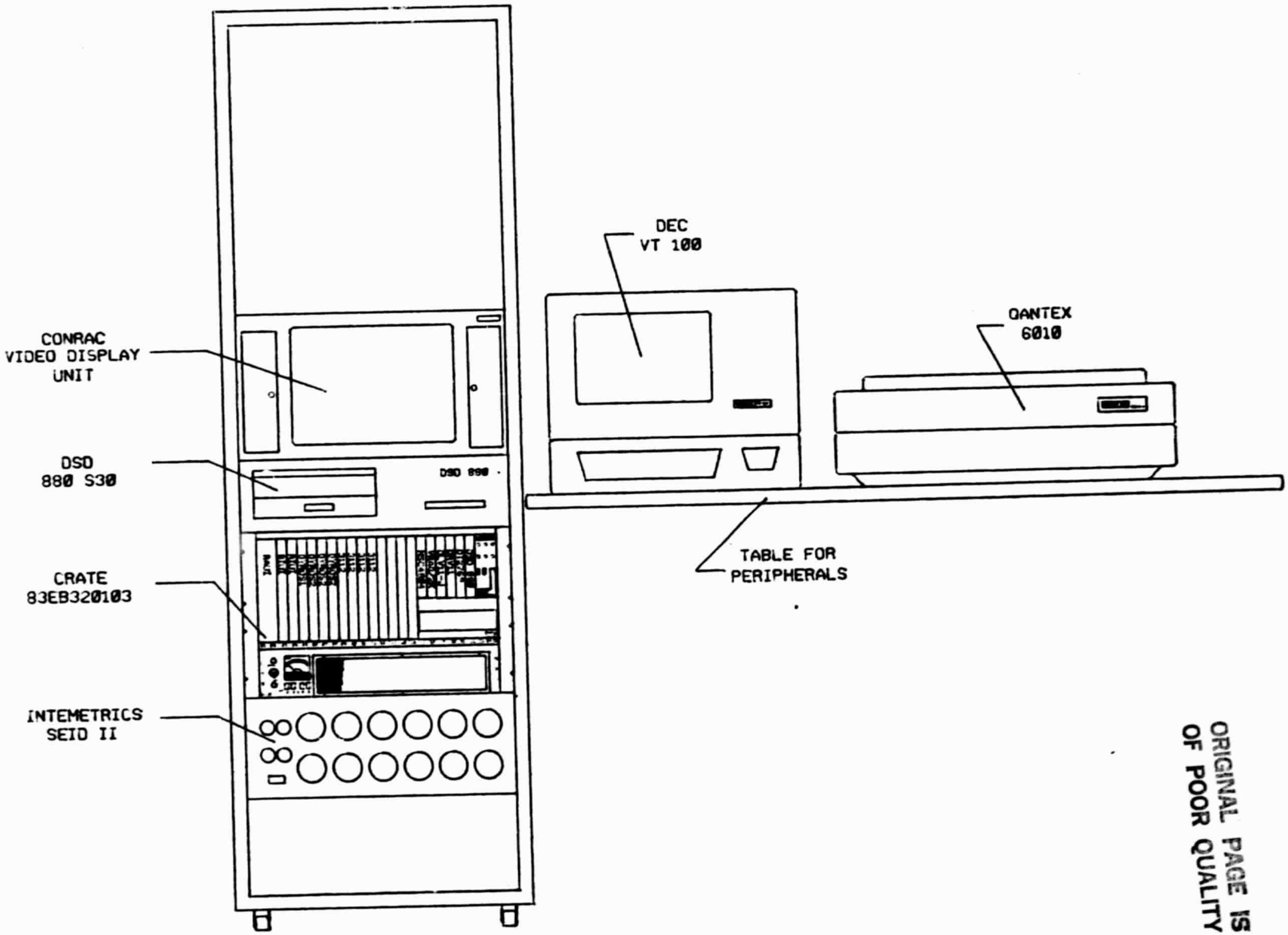

FIGURE 2-4: PDSS/IMC GSE LAYOUT

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TABLE 2-1: PDSS/IMC - IMCE INTERFACE SUMMARY

PDSS/IMC INTERFACE	IMCE INTERFACE: TMI	UIT	WUPPE	ASTROS	DRIRU-II	POWER	ECOS
SEID UTC	1024KHZ 4PPS						
SEID ON/OFF (DO'S)					DO/DIO RANGE STATUS TELEMETRY OUTPUT	DO/PWR ON/OFF	
SEID FI'S				FI/DIO ASTRO STATUS SIGNALS	FI/DEI ELECTRICAL INTERFACE MODE COMMANDS	FI/PWR POWER SIGNALS	FI/RAUI ERROR
SEID SERIAL PCM							PCM/RAUI ECOS SERIAL
CAMAC RAUI				RAUI/RAUS ASTROS SERIAL			
CAMAC RIUI		RIUI/DEI UIT SERIAL	RIUI/DEI WUPPE SERIAL				
CAMAC GYROS					GYROS/DEI PULSES		
CAMAC 3112		AO/A-D UIT ANALOG		AO/A-D ASTROS TEMP., POWER,ETC. SIGNALS	AO/A-D ANALOG RATE TELEMETRY OUTPUT	AO/A-D SIGNAL DRIVERS	
CAMAC TEMPERATURE SWITCHES					SW/A-D TEMPERATURE		

2.1.1 PDSS/SEID

PDSS/SEID provides a Spacelab Experiment Computer/RAU simulated environment for diagnostic and verification testing of experiment subsystems.

PDSS provides the simulated ECOS functions for test and verification of DEP Services and DDS operation.

The SEID is a simulated Spacelab CDMS/RAU interface for Spacelab experiments. The SEID simulates the electrical and logical connections to the Remote Acquisition Unit (RAU) and the High Rate Multiplexor (HRM). The SEID meets ESA and NASA electrical, level, drive and loading requirments for RAU and HRM interfaces. It has compatible signal timing for the Pulse Code Modulation (PCM), User Time Clock (UTC), and High Rate Multiplexor (HRM).

The PDSS/SEID will interface with the IMCE Discrete Input/Output card. The following table (Table 2-2) specifies the SEID's Discrete Output (ON/OFF Commands) and Flexible Input interfaces to the DIO and DEI cards. The DIO has 4 sets of 16 Discrete channels for a total of 64 Discrete channels. The DIO Discrete channels can be strapped for Discrete Output or Discrete Input. The DEI card has a total of 16 Discrete Output channels.

2.1.2 RAUI

The RAUI is a CAMAC module to permit serial data transfers to occur with a RAU. The protocol followed is that specified by the SPAH for serial inputs and outputs. For serial inputs the RAUI raises the serial input request line and then responds to

the serial input clock to transfer one to thirty two sixteen bit words to the RAU. For serial output the RAUI responds to the serial output clock and accepts one to thirty two sixteen bit words from the RAU. Detailed RAUI specifications are in 15M30124 Operation and Maintenance Manual.

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TABLE 2-2: PUSS/INC - DEI/DIO

CHANNEL CARD \ XX			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
0,XX	DIO	CØ	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
		TYPE	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DI	DI	DI	DI
			TEC	CVR	MST													
		SØ	16	17	18	19	20	21	22	23	24	25	26	27	12	13	14	15
		TYPE	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	DO	DO	DO	DO
1,XX	DIO	CØ	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
		TYPE	DI	DI	DI	DI	DI	DI	DI	DI	DI	DI	DI	DI				
		RST---	X1A		X1B		Y1B		Y1C		Z1A		Z1C					
		SØ	00	01	02	03	04	05	06	07	08	09	10	11				
		TYPE	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO				
2,XX	DIO	CØ	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
		TYPE	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DI	DI	DI	DI
		SØ	48	49	50	51	52	53	54	55	56	57	58	59	28	29	30	31
		TYPE	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	DO	DO	DO	DO
3,XX	DIO	CØ	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
		TYPE	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DI	DI	DI	DI
		SØ	80	81	82	83	84	85	86	87	88	90	91	92	44	45	46	47
		TYPE	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	DO	DO	DO	DO
4,XX	DEI	CØ	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
		TYPE	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	
		RR---	H1A	H2A	L1A	L2A	H1B	H2B	L1B	L2B	H1C	H2C	L1C	L2C				
		SØ	00	01	02	03	04	05	06	07	08	09	10	11				
		TYPE	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	RIUI	RIUI	RIUI	

CØ = DEI OR DIO CHANNEL NUMBER (HEX)
SØ = SEID CHANNEL NUMBER

2.1.3 RIUI

The RIUI is a CAMAC module that accepts data in the RIUI protocol for command data only. The RIUI responds to the enable and clock to accept the serial data (16 bits). A detailed specification is contained in S-700-54 Rev B Standard Telemetry and Command Components Remote Interface Unit (RIU) User's Guide. Table 2-3 summarizes the RIUI CAMAC Commands.

TABLE 2-3: RIUI CAMAC COMMANDS

COMMAND CODE	FUNCTION
NF(26)	ENABLE LAM MASK (SET) UIT/WUPPE
NF(24)	DISABLE LAM MASK (RESET) UIT/WUPPE
NF(10) A(0)	CLEAR LAM0 UIT
NF(10) A(1)	CLEAR LAM1 UIT
NF(10) A(2)	CLEAR LAM2 WUPPE
NF(27) A(0)	TEST STATUS LAM0 UIT
NF(27) A(1)	TEST STATUS LAM1 UIT
NF(27) A(2)	TEST STATUS LAM2 WUPPE
NF(8)	TEST LAM
NF(0) A(0)	READ REG 0 UIT
NF(0) A(1)	READ REG 1 UIT
NF(0) A(2)	READ REG 2 WUPPE

2.1.4 CAMAC 3112

The 3112 is a standard off the shelf CAMAC module that is a 12 bit digital to analog converter. The module has eight registers that can be loaded to produce eight analog outputs.

2.1.5 GYROS

The GYROS is a CAMAC module that simulates the X, Y, and Z axis pulse outputs of the DRIRU II GYRO package. The module provides twelve 16 bit registers (two for each axis) that are loaded by dataway commands. These registers control the pulse rate as well as the total pulse output.

The GYROS board will be designed to accept pulse commands for positive and negative commands for 6 channels (2X, 2Y, and 2Z) for a total of 12 pulse channels.

The GYROS design will have three registers for each pulse channel. The first register (16 bits) will contain the pulse count. The pulse count values will range from 1 to 65,535 (0001H to FFFFH). The second register (16 bits) will contain the direction and pulse rate. The sign bit will designate the pulse direction (0 = positive and 1 = negative). The pulse rate will be specified as a multiple of .01KHZ(40.96KZ/4096). A register value of 1 (0001H) will specify a pulse rate of 10HZ and a register value of 32,767 (7FFFH) will specify a pulse rate of 327.67KHZ. A pulse rate register value of 0 will terminate pulse rate outputs. The GYROS interface will provide a LAM that indicates completion of a pulse count output. The third register when loaded to a non zero value will initiate the pulse train output.

The GYROS card will simulate the three temperature measurement thermisters with two switch settings per thermister (high value = 55°C and low value = 15°C).

Table 2-4 summarizes the CAMAC commands the GYROS card will provide.

TABLE 2-4: GYROS CAMAC COMMANDS

COMMAND CODE	FUNCTION
NF(26) A(X)	ENABLE LAM MASK (SET)
NF(24) A(X)	DISABLE LAM MASK (RESET)
NF(10) A(X)	CLEAR LAM
NF(27) A(X)	TEST STATUS LAM
NF(8)	TEST LAM
NF(16) A(X)	WRITE GROUP 1 REG BINARY RATE
NF(17) A(X)	WRITE GROUP 2 REG COUNT
NF(20) A(X)	WRITE SPECIAL REG CONTROL (START, STOP)

Where

	GYROS2/06	GYROS2/07	GYROS2/08
X = 0	DTXA	DTXB	DTYC
X = [illegible]	DTZA	DTYB	DTZC

2.1.6 CABLING

GSE cables will be provided to interface the IMCE and PDSS/IMC. All signals required for Acceptance Testing and Flight Software Design will be interconnected.

The PDSS/IMC GSE cables will be as defined by NASA Drawing 83EB320106 as prepared by the Information and Electronic Systems Laboratory.

2.2 PDSS/IMC SOFTWARE DESCRIPTION

PDSS/IMC will include the following software packages.

- RT-11 Operating System (V5.0)
- PDSS System Software (V2.0)
- PDSS/IMC Qualification Test Software
- PDSS/IMC Computer Simulation Software
- PDSS/IMC Post Processing Software
- PDSS/IMC Utility Software
- PDSS/IMC Experiment Application Software (Displays)

Figure 2-5 defines the relationship between the PDSS/IMC software packages.

The PDSS System Software (V2.0) will be the standard PDSS software as defined in Section 3.0 including the PDSS/IMC Experiment Application Software.

Section 4.0 defines the requirements for PDSS/IMC Qualification Test Software.

Section 5.0 defines the requirements for PDSS/IMC Computer Interface Simulation software.

Section 6.0 defines the requirements for PDSS/IMC Utility Software.

Section 7.0 defines the requirements for PDSS/IMC Post Processing Software.

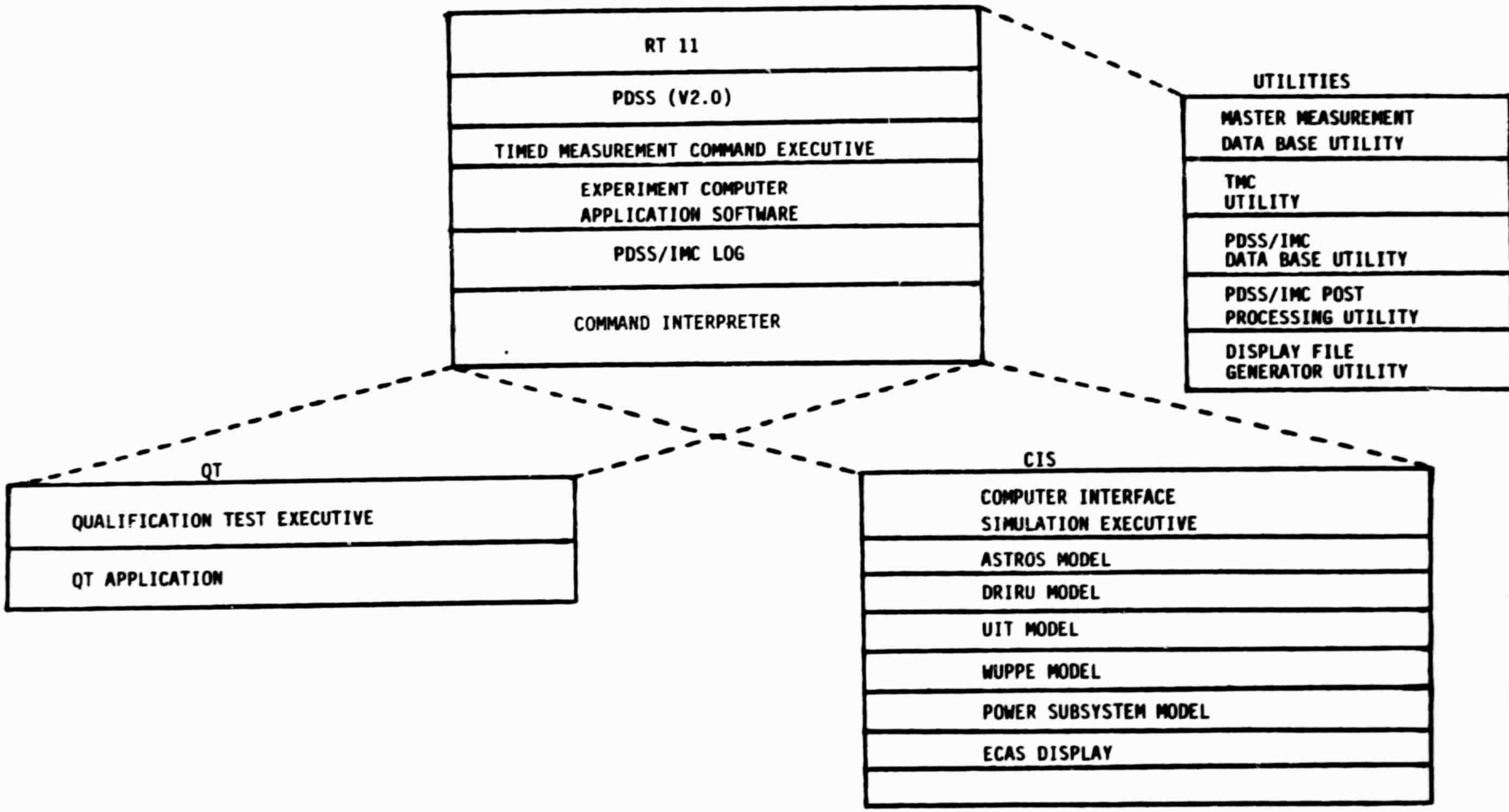


FIGURE 2-5: PDSS/IMC SOFTWARE

2.3 PDSS/IMC TEST LANGUAGE

A comprehensive and easy-to-use command language that allows the user to perform individual functions will be provided. The PDSS/IMC command language will provide the capability to perform the following operations.

1. Stop and Start Test Execution
2. Execute operator defined sequence continuously
3. For each "issue" allow operator to define data values
4. For each "read" allow operator to define PDSS/IMC values
5. Insert continuation markers on command lines
6. Reinitialize counters and display
7. Activate and de-activate log
8. Execute operator defined single functions
9. Pause and resume test Execution
10. Single step sequence
11. Inhibit PDSS/IMC write, read, or compare logic
12. Insert comments or command lines

The PDSS/IMC commands will have the following format.

"=XXXX p1,p2,... CR"

XXXX = Four character ID for command
p1 = parameter #1
p2 = parameter #2
CR = Carriage Return

PDSS/IMC commands will be accepted on minimum character identifiers; that is, most commands will require only two character identifiers.

All PDSS/IMC command data will be optional. Standard defaults or the last entered data will be used. The command data will be entered as either hexadecimal or character strings.

For commands that require multi-line operator commands, two modes of input will be supported. The PDSS/IMC command handler will automatically reposition for continued data input with no maximum on input lines. Upon detection of a continuation character for keyboard entry or for file entry), PDSS/IMC will reposition for read of new input line. The continuation character will be ";".

The first character "=" designates the keyboard input as a user command. For PDSS/IMC, the user commands will be routed to the PDSS/IMC Command Interpreter Module.

All keyboard inputs must be terminated by a Carriage Return.

Entry of the command "=" will cause the last Command to be re-executed.

The PDSS/IMC Command Interpreter Module will provide the operator commands listed in Table 2-5 and described in the following sections.

TABLE 2-5: PDSS/IMC TEST LANGUAGE SUMMARY

COMMAND	FUNCTION
=COMM	Log comment on Log File
=DISPLAY	Select Display Page
=LOG	Activate Log
=MODIFY	Modify PDSS/IMC Data
=NLOG	Deactivate Log
=PIO	Perform I/O to PDSS/IMC Sensors
=PLOG	Print Log
=PMEM	Print Memory
=SRST	System Reset
=START	Start Test
=STOP	Stop Test
=TASK	Activate/Deactivate Tasks and Set Priority
=TMC	Select Timed Measurement Command
=VIEW	Display or Print PDSS/IMC Data
=<BLUE>	Single Step TMC
=<RED>	Pause/Resume TMC

2.3.1 Log Comment (COMM)

A PDSS/IMC user command will allow the operator to enter a comment line for logging to the Log File.

The syntax of the Log comment command is:

"=COMM CHARACTER-STRING'

The 64 maximum byte character-string is written to disk along with the current GMT.

2.3.2 DISPLAY SELECT (DISPLAY)

A PDSS/IMC user command will allow the operator to select and control a PDSS/IMC display page. The syntax of the DISPLAY SELECT command is:

"=DISPLAY/c page"

page = Display Page Identifier
c = I -- Reinitialize Display Page
= F -- Freeze Display
= U -- Update Display

2.3.3 LOG ON (LOG)

A PDSS/IMC user command will allow the operator to activate the PDSS/IMC log function. The activate command permits the operator to specify the logging rate defined in multiples of one (1) second. The syntax of the LOG ON command is:

"=LOG nn"

nn = multiples of one (1) second

A "=LOG 1" command will cause the PDSS/IMC Data Structure to be logged every second. A "=LOG 10" command will cause the PDSS/IMC Data Structure to be logged every 10 seconds. The Log rate ranges from 1 to 100 seconds. If the log rate is not specified ("=LOG"), the log rate will be the last specified rate.

2.3.4 MODIFY

A PDSS/IMC user command will allow the operator to modify data in the PDSS/IMC data structure. The syntax of the modify command is:

"=MOD index, hexdata, ..., hexdata"

2.3.5 LOG OFF (NLOG).

The "=NLOG" command will stop the logging function. The log file will remain open. A new "=LOG" command will continue logging to the log file at the point where the log operation was stopped.

The format of the log off command is:

"NLOG"

2.3.6 PERFORM I/O (PIO)

The PDSS/IMC user command will allow the operator to perform direct I/O operations to PDSS/IMC sensors.

The operator will have the capability to:

- Read SEID Flexible (Discrete or Analog) Inputs
- Read SEID Serial PCM Channels
- Write SEID Discrete Outputs (ON/OFF)
- Write SEID Serial PCM Channels
- Write PDSS/IMC Analog Output
- Write PDSS/IMC RAUI
- Read PDSS/IMC RAUI
- Write PDSS/IMC RAUS
- Read PDSS/IMC RAUS
- Read PDSS/IMC RIUI
- Write PDSS/IMC Gyro

The format of the Perform I/O command is:

"=PIO sensor id, data"

The "=PIO sensor id, data" command will cause the data to be sent to the designated sensor. The type commands that will be supported by the PIO command include the following:

```
SET     AO #j TO   VALUE
PULSE   AO #j FROM VALUE-1 TO VALUE-2 IN TIME-1
RAMP    AO #j FROM VALUE-1 TO VALUE-2 IN TIME-1

SET     DO #i TO   ON/OFF
PULSE   DO #i FROM ON/OFF  TO OFF/ON IN TIME-1

SET     SERIAL #i  TO  data-1, ..., data-n
```

SET GYROS-PULSES Channel #i TO count, sign, rate

SET ASTROS-DATA #X,Y TO X,Y,DX,DY, #INCREMENTS

DELAY T - DELAY T * 100 MILLISECONDS

WAIT CONDITION - TEST FOR CONDITION EVENT (1/second)

CONDITIONS = ASTROS STANDBY MODE
ASTROS ACQUISITION MODE
ASTROS TRACK MODE
ASTROS DEFLECT MAP MODE

DI #i ON
DI #i OFF
AI #j $\geq$V
AI #j $\leq$V
GMT

2.3.7 <u>PRINT LOG (PLOG)</u>

PLOG prints the PDSS/IMC Log. The format of the print log command is:

"=PLOG from-time to time"

The log will be printed per the requirements specified in Section 7.0. The time parameters will be specified in the GMT format:

ddd:mmmmmmmm

2.3.8 PRINT MEMORY (PMEM)

PMEM prints the PDSS/IMC memory information. The memory information includes:

- Command mnemonic and command code
- Current output data
- Current input data
- Last received response data where failure detected
- Last received response
- Count of number of passes
- Count of number of IMCE detected errors
- Count of IMCE failure to respond or acknowledge
- Count of PDSS/IMC detected failures
- Measurement Compare Table

The syntax of the print memory command is:

"=PMEM"

2.3.9 SYSTEM RESET (SRST)

The System Reset command will cause PDSS/IMC and IMCE to terminate all on going functions and to re-establish the power up state for all signals.

"=SRST"

PDSS/IMC and IMCE will execute their power up routines and will then enter a standby state.

2.3.10 START

A PDSS/IMC user command will allow the operator to start the test execution.

The syntax for the START command is:

"=START'

The start command will initiate task dispatching, logging, display updates, Timed Measurement Command processing, Experiment Application software, and CAMAC and SEID IO.

2.3.11 STOP

A PDSS/IMC user command will allow the operator to stop test execution. All PDSS/IMC CAMAC Crate and SEID I/O activity is terminated. The Log file will be closed. The Time Measurement Command file will be closed. PDSS/IMC will enter a standby mode.

The syntax for the STOP command is:

"=STOP"

2.3.12 TASK

A PDSS/IMC user command will allow the operator to query, activate or deactivate PDSS/IMC models. The syntax of the TASK command is:

"=TASK [idp [,idp [...]]]
id = Task id
p = Priority

The command "=TASK" will cause the current task table to be displayed on the system console. The format of the task table display for Computer Interface Simulation will be:

ID	TASK	PRIORITY
DR	DRIRU	01
AS	ASTROS	02
UI	UIT	03
WU	WUPPE	04
CI	COMMAND INT.	05
DD	DATA DISPLAY	06
LG	LOG	07
SE	SEID GML	08
EC	ECOS	09

An entry will be provided in the task table for all of the PDSS/IMC tasks. Each task will have a two character ID and a priority number. The priority of the tasks are 0 to 9. A priority of 0 (zero) indicates that the task is inactive. A priority of 1 (one) indicates the lowest active priority, and a priority of 9 (nine) indicates the highest priority.

The priority and activation/deactivation of PDSS/IMC task are determined by the TASK command.

"=TASK ASO, DR4"

This command deactivates task AS (ASTROS) and places task DR (DRIRU) on priority level 4. Other tasks are not affected.

The format of the task table display for the Qualification Test will be:

ID	TASK	PRIORITY
01	XIIT	1
02	XIMT	1
03	RDRI	1
04	RDIS	1
05	RALG	1
06	RGYR	1
07	RDRS	1
08	ISON	1
09	ISOF	1
0A	ISOT	1
0B	IDWP	1
0C	IDUI	1
0D	IDRS	1
0E	SGMT	1
0F	RGMT	1
10	XPIT	1
11	XPMT	1
12	XHRM	1
13	XTPT	0
14	SSPR	0
15	XINT	0

For Qualification Test software the priority range is 0 to 1; 0 = off and 1 = active. This priority applies for execution of the special Qualification Test sequence.

2.3.13 TIMED MEASUREMENT COMMAND (TMC)

A PDSS/IMC user command will allow the operator to select, restart, or halt the processing of the Timed Measurement command data file.

The syntax of the TMC command is:

"=TMC/c filename"

c = L -- Load Only
  = X -- Execute
  = I -- Reinitialize
  = E -- Stop on Errot

The "=TMC filename" command causes the previous mission profile data stream to be terminated (if active), new data file to be opened, and profile processing to be initiated.

The <RED> function key will be used for a pause/restart capability for the TMC (see Section 2.3.16).

The <BLUE> function key will be used for a single step capability for the TMC (see Section 2.3.17).

2.3.14 VIEW

A PDSS/IMC user command will allow the operator to look at the contents of the PDSS/IMC data structure. The contents will be displayed on the system console and/or line printer. The syntax of the VIEW command is:

"=VIEW [/H] index"

index = word (16 bit) index or relative address
into the PDSS/IMC data structure

The /H option causes the data to be output to the line printer.

The VIEW command "=VIEW 20" would cause the following data to be output to the system console.

PDSS/IMC DATA

INDEX	DATA							
20	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
28	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

To have the same data output to the line printer the command "=VIEW/H 20" would be entered.

2.3.15 SINGLE STEP SEQUENCE <BLUE>

The BLUE function key is used as a single step action key. The key is only active when a PDSS/IMC sequence is active and the PAUSE command has been keyed.

"=<BLUE>"

2.3.16 PAUSE/RESUME SEQUENCE <RED>

The RED funcion key provides a PAUSE/RESUME capability for sequences.

"=<RED>"

2.4 TIMED MEASUREMENT COMMANDS

PDSS/IMC will provide a capability to have a time sequenced measurement command file that contains a set of user specified measurement and system commands. PDSS/IMC will provide the capability to:

- Generate a Timed Measurement Command File
- Edit a Timed Measurement Command File
- Merge Time Measurement Command Files

The Timed Measurement Commands will be keyed to GMT; therefore, the time accuracy will be 250 milliseconds.

As illustrated in Figure 2-6, PDSS/IMC will generate a single Time Measurement Command file for processing in real time by PDSS/IMC.

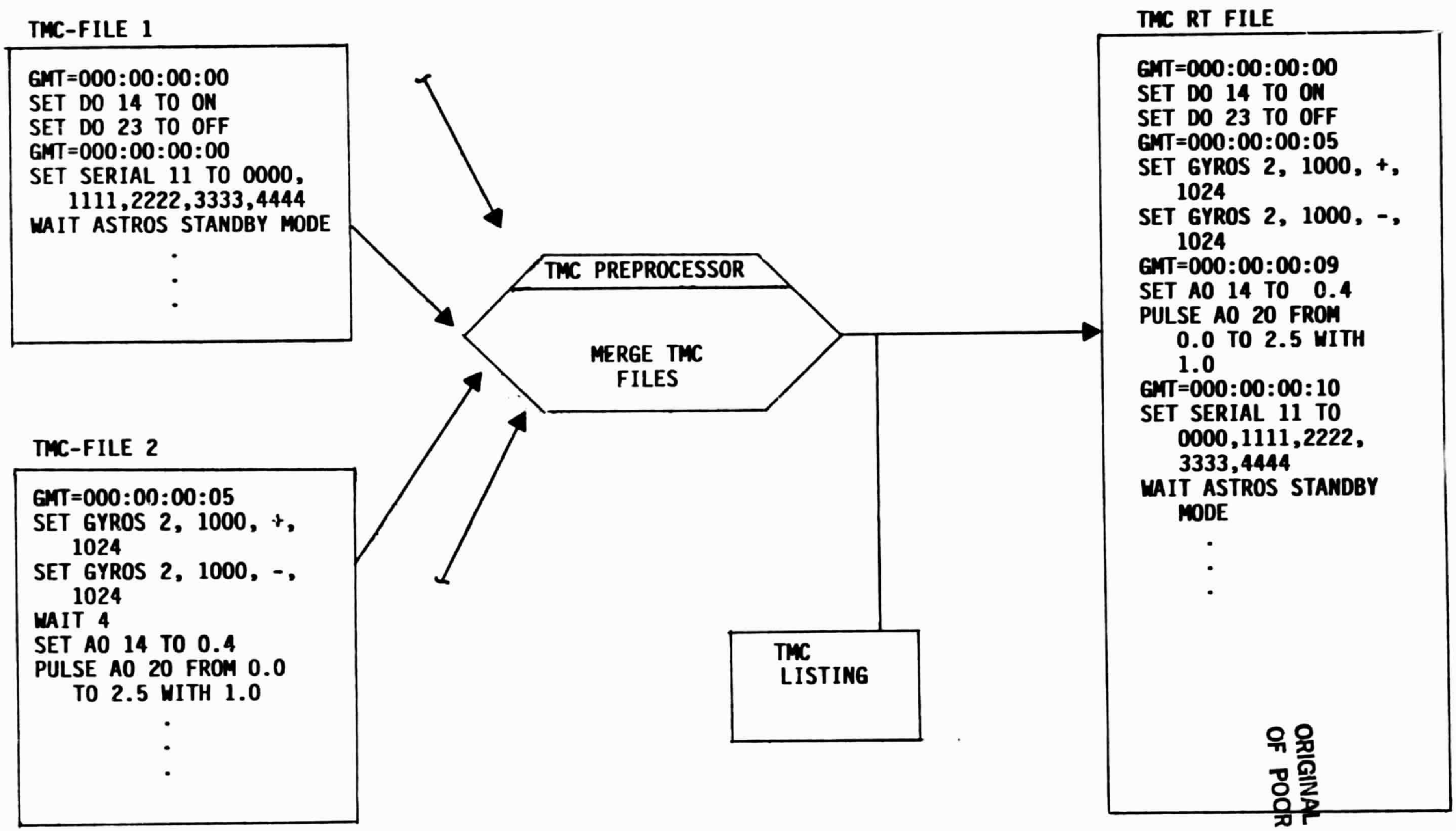


FIGURE 2-6: TIMED MEASUREMENT FILES

Users will have the capability to predefine sequences of PDSS/IMC commands for later execution. All PDSS/IMC commands that invoke IMCE functions or control PDSS/IMC operation can be placed in a sequence.

A PDSS/IMC Qualification Test sequence will consist of a set of PDSS/IMC commands that will be executed in sequence. The Test sequence can be repeated continuously or can be repeated for an operator specified number of passes.

Only one TMC sequence will be loaded and resident in memory. Single operator (keyboard) PDSS/IMC commands will be allowed to be issued in parallel with TMC sequence commands. The single commands will be queued until the current active sequence command has completed; then, the single command is performed. After completion of the single command, the sequence commands will be resumed.

The TMC files will be generated by a standard DEC editor program and will consist of strings of characters. A load command will specify the file to be read for command sequences. Preprocessing of the sequence commands will be performed. Any detected errors will be displayed to the operator and the load operation terminated. The execute sequence command will only be valid when a successful load operation has been performed.

The Sequence Command files will provide for the following type command lines:

- PDSS/IMC-IMCE Commands
- PDSS/IMC System Commands
- Comment Lines
- Continuation Lines for Commands
- Include Commands for Other TMC Files

Multiple TMC files will be maintained on the system disk.

A special Qualification Test sequence will be defined as the sequence of commands starting with XIIT (01) and ending with XHRM (12). See Table 4-2 for those commands that are executed as the special sequence. The operator will have the capability to start the special Qualification Test in the same manner as other sequences. The operator will also have the capability to activate or deactivate individual commands.

3.0 PDSS/IMC PDSS FUNCTION SOFTWARE

PDSS/IMC will provide the standard system capabilities of the PDSS for simulating the Spacelab electrical interfaces to a Remote Acquisition Unit (RAU) and the standard software interface services provided by the Spacelab Experiment Computer Operating System (ECOS).

The Image Motion Compensation Electronics (IMCE) system will use the Spacelab CDMS standard interfaces (RAU, HRM, ECAS, ECI, ECOS DEP Services) such as:

- Receive mode and configuration commands (Payload Specialist/Experiment Computer)
- Receive microprocessor memory load
- Receive commands and data from Payload Specialist for activation/deactivation
- Receive data from IPS OSP
- Transmit data for display to the Payload Crew
- Transmit data to the POCC for recording/display in real time

PDSS/IMC PDSS Function software will include the use of the following PDSS capabilities:

- PDSS General Measurement Loop
- SEID General Measurement Loop
- PDSS DDS Display Services
- PDSS Timeline
- PDSS DEP Services

PDSS Function software will be standard PDSS software programs.

An Experiment Application Software program that provides IMCE Display simulation will be developed. The PDSS/IMC software will be scoped to support no more than 3 Experiment Computer Display pages. The PDSS/IMC DDU services will be utilized to provide simulation of the IMCE Display pages and associated functions. Definition of the Experiment Computer Display pages are required by July 19, 1983.

4.0 PDSS/IMC QUALIFICATION TEST SOFTWARE

The PDSS/IMC Qualification Test Software will support the PDSS/IMC during IMCE flight computer system qualification testing. PDSS/IMC Qualification Test Software and the corresponding IMCE flight computer qualification test software will provide the capability for IMCE hardware and software fault detection, fault isolation, and fault presentation. A flexible, user-friendly man machine interface capability for issuing commands and monitoring of measurements will be provided.

For Qualification testing, the PDSS/IMC processor will send serial command messages to the IMCE flight processor. After performing the desired function, the IMCE flight processor will transmit a serial response message to PDSS/IMC.

The PDSS/IMC Qualification Test Software will be structured to operate in both a single command mode or in an automatic command mode. For the single command mode, the operator will key in a qualification test command; the command will be transmitted to the IMCE flight processor; the associated function will be executed; the response data will be transmitted to PDSS/IMC; the response and status will be displayed to the operator; and PDSS/IMC will verify the response data and system state.

The automatic mode of operation will provide for the continuous execution of a sequence of qualification test commands with a continuous monitoring and displaying of test results. Automatic mode of operation will be terminated by (1) an operator command, (2) completion of the requested number of iterations, or (3) an occurrance of an error condition.

The operator will have the capability to activate and deactivate logging of Qualification Test data. When the log is active, operator entries, command messages, and response messages will be recorded.

4.1 PDSS/IMC QUALIFICATION TEST SOFTWARE CONCEPTS

PDSS/IMC will use the IMCE RAUI interface to transmit command messages and to receive response messages from the IMCE flight processor.

Each command message from PDSS/IMC to IMCE or response message from IMCE to PDSS/IMC will require an acknowledge message from the receiving processor.

All command messages sent to the IMCE will require a response message containing the IMCE status word and IMCE function data.

Command messages sent to the IMCE that require the IMCE to perform input operations will require a response message containing the data that was acquired by the IMCE.

During Qualification testing, the PCC will output the IMC flight PCM format. The operator will have the capability to command the IMCE processor to activate and deactivate the PCC PCM format output

After completion of each IMCE function, PDSS/IMC will verify that IMCE acquired response data is correct and that PDSS/IMC acquired data is also correct. The measurement testing will insure that logically connected measurements are consistent and also that measurement changes are not detected for non-logically connected measurements.

The PDSS/IMC will maintain the following information in memory for each PDSS/IMC command.

1. Command mnemonic and command code.
2. Current output data
3. Current input data
4. Last received response data where failure detected
5. Last received response
6. Count of number of passes
7. Count of number of IMCE detected errors
8. Count of number of IMCE failures to respond or acknowledge
9. Count of number of PDSS/IMC detected failures

The PDSS/IMC memory information will be output to the line printer on operator command.

Upon initial program load, the operator will be prompted for the date, time (GMT), and test ID. This information will be printed on all outputs.

PDSS/IMC will provide a set of default data parameters for each command.

The PDSS/IMC will power up in a known state. Table 4-1 defines the state of the PDSS/IMC measurements.

The PDSS/IMC will be designed and integrated in a method that permits testing of the individual modules and interfaces.

TABLE 4-1: PDSS/IMC POWER UP STATE

SIGNAL	STATE
SEID	
64 DO'S (ON/OFF)	OFF
CAMAC/IMC	
32 AO'S	0.0V
3 RIUI	No Serial Input
12 GYROS	0 Pulses
1 RAUI	No Serial Output
IMCE	
1 RAUS	No Serial Output
32 A/D	0.0V
DEI	No Serial Output
64 DIO	OFF
RAUI	No Serial Output

4.2 PDSS/IMC QUALIFICATION TEST SOFTWARE PROTOCOL

The PDSS/IMC control logic will be structured to allow SINGLE commands to be interdispersed with SEQUENCE commands as illustrated in Figure 4-1.

The Qualification Test command and response protocol between PDSS/IMC and the IMCE processor will be defined to utilize the Spacelab Experiment Computer DEP Services DEP User Message Block. The PDSS/IMC processor will control the command and response protocol as illustrated in Figure 4-2.

```
QUAL-LOOP:  REPEAT
     IF SINGLE COMMAND IN QUEUE
         THEN:
            MARK SINGLE COMMAND FOR EXECUTION
         ELSE:
            IF SEQUENCE MODE
                THEN:
                   REMOVE SEQUENCE COMMAND FROM STACK
                   MARK COMMAND FOR EXECUTION
            ENDIF
     ENDIF
     BEGIN EXECUTION BLOCK:
         IF COMMAND MARKED FOR EXECUTION
            THEN:
                PERFORM INITIALIZATION FOR COMMAND
                SEND COMMAND MESSAGE
                WAIT FOR ACKNOWLEDGE
                DO UNTIL RESPONSE MESSAGES RECEIVED
                   WAIT RESPONSE
                   SEND ACKNOWLEDGE
                ENDDO
                PERFORM COMPARISON TESTS
         ENDIF
END
```

FIGURE 4-1: PDSS/IMC QT CONTROL LOGIC

STEP	CONDITION	IMCE	PDSS/IMC
1	IMCE POWER-UP		
2	IMCE IN STANDBY MODE WAITING ON COMMAND		WAIT ON OPERATOR INPUT
3			<---DEP USER MSG COMMAND
4		ACKNOWLEDGE--->	
5		PERFORM FUNCTION	IDLE WITH 10 SECOND TIMEOUT
6	IMCE FUNCTION COMPLETE	DEP USER MSG RESPONSE------>	
7			<---ACKNOWLEDGE
8	REPEAT STEPS #6 & #7 UNTIL RESPONSE COMPLETED		
9			VERIFY RESPONSE & SYSTEM STATE
10	RETURN TO STEP #2		

FIGURE 4-2: PDSS/IMC QT PROTOCOL

STEP 1: After power-on, the IMCE processor will perform the minimum amount of initialization logic to bring the processor to a standby state ready to accept serial input messages on the RAU PCM channel interface. The IMCE processor will clear its GYROS pulse count registers and initiate a sample of the GYRO pulses (12 channels) at a 250 millisecond rate.

STEP 2: After IMCE power up initialization or completion of a command (see Step #10), the following state will be established.

1. The IMCE processor will enter a standby mode to wait on Qualification Test commands from the PDSS/IMC. The IMCE processor will acquire and accumulate GYRO pulse data. The pulse data will be read at least every 250 milliseconds. PDSS/IMC will provide a command to inhibit or continue the IMCE synchronous read of pulse data.

2. The PDSS/IMC processor will enter an idle mode to wait for operator keyboard commands. Upon receipt of a valid operator command, PDSS/IMC will transmit a DEP Users Message to IMCE (Step 3). Invalid operator commands will not cause the transmission of a DEP Users Message. The operator will be notified if an operator command is not accepted.

STEP 3: Upon receipt of a valid operator command, PDSS/IMC will send a DEP Users Message to IMCE to initiate the function requested. The DEP Users Message will be in format of a PDSS/IMC Command Message Block. Only one command can be sent per message block.

STEP 4: Upon receipt of a Command Message from PDSS/IMC, IMCE will respond with an acknowledge. If IMCE does not respond with an acknowledge within 10 seconds, PDSS/IMC will notify the operator and terminate the command function; i.e., return to Step #2.

STEP 5: The IMCE processor will initiate execution of the requested Qualification Test function. Section 4.5 defines the specifics for each of the functions. The PDSS/IMC processor enters an idle state with a 10 second watchdog timer active. If the timer event occurs before a response message from the IMCE, the operator will be notified, the command terminated, and control flow returned to Step #2.

STEP 6: When the IMCE processor has completed the requested function, the response data will be collected and transmitted to PLSS/IMC. A response will be generated and transmitted for successful or failed executions for any of the Qual Test functions. Based on the function performed, the response may require multiple messages to transmit the response data.

STEP 7: After receipt of each IMCE function response message, PDSS/IMC will respond with an acknowledge.

STEP 8: Steps #6 and #7 will be repeated until all response messages for the executed function have been transmitted to PDSS/IMC.

STEP 9: PDSS/IMC will verify the response data for correctness. The state of all PDSS/IMC sensors will be verified to insure no cross talk for commands.

STEP 10: Upon completion of a requested function, PDSS/IMC will update the display page and then return to Step #2 to await the entry of an operator command.

4.3 PDSS/IMC QUALIFICATION TEST SOFTWARE MESSAGE FORMATS

The PDSS/IMC and IMCE will communicate over a serial PCM channel employing a maximum of 32 words (16 bit) per message. The messages will be in the format shown in Figure 4-3.

The length field ('LLLL') for the Command Messages will be the total number of words on the message minus 2.

The Function Code ('FF') for the command Message will be an integer code as identified in section 4.5.

Words 3-31 contents vary for each function requested by PDSS/IMC and for each reply by IMCE.

The length field ('LL') for the Response Message will be the total number of words minus 1.

The IMCE(808X-PCC) error code ('ssss') will have the following format:

Status Code = |n|m|m|m|

where	n = 8	Pulse Sync Read Active
	0	Pulse Sync Read Inactive
	n = 4	Throughput Test Active
	0	Throughput Test Inactive
	mmm =	User defined (see Section 4.5)

PDSS/IMC COMMAND MESSAGES	Word 0	F 0 0 0	
	1	1 3 0 3	
	2	L L L L	LLLL = Total Number of words - 2
	3	0 0 F F	FF = Function Code
	4	d d d d	dddd = Data
		. . . .	
	31	d d d d	
PDSS/IMC Acknowledge	Word 0	F 0 0 0	
	1	1 1 8 1	
IMCE RESPONSE MESSAGE	Word 0	1 2 8 1	
	1	0 0 L L	
	2	s s s s	LL = Total Number of words - 1
	3	d d d d	
		. . . .	ssss = Status Code
	31	d d d d	dddd = Data
IMCE Acknowledge	Word 0	1 2 0 0	

FIGURE 4-3: PDSS/IMC-IMCE MESSAGE FORMAT

4.4 PDSS/IMC QUALIFICATION TEST COMMANDS/FUNCTIONS

PDSS/IMC will provide a set of test commands that exercise and verify IMCE interfaces in a singular, controlled environment.

PDSS/IMC will provide the following Qualification Test commands as a minumum. For each command, the associated function and data parameters are defined. Table 4-2 summarizes the PDSS/IMC Qualification Test commands.

For each command, the following sections define:

- Command Mnemonic and code
- Command Data Parameters
- Default Values
- Command Message Format
- Response Message Format
- Verification

The Command Data Parameters are the data parameters associated with the command. PDSS/IMC will provide default values for the commands. Unless data parameters are entered by the operator, the default values or last entered values will be used.

The verification process that PDSS/IMC will perform for each of the commands will consist of the following:

- Verify the contents of the response message
- Verify the status of measurements that are directly affected by the command
- Verify the status of measurements that are not affected by the command

The verification logic will verify the expected responses and those that are not expected.

TABLE 4-2: QUALIFICATION TEST FUNCTION CODES

COMMAND	SP	FUNCTION CODE MESSAGES	# COMMAND MESSAGES	# RESPONSE FUNCTION	QUALIFICATION TEST
XIIT	*	01	1	1	Execute IMCE DEP Instruction Self-test
XIMT	*	02	1	1	Execute IMCE DEP Memory Test
RDRI	*	03	1	2	Read DATA RAUI
RDIS	*	04	1	1	Read Discrete Inputs
RALG	*	05	1	2	Read Analog Inputs
RGYR	*	06	1	1	Read Rate Inputs
RDRS	*	07	1	2	Read RAUS Inputs
ISON	*	08	1	1	Issue Discrete Out ON
ISOF	*	09	1	1	Issue Discrete Out OFF
ISOT	*	0A	1	1	Issue Discrete Out
IDWP	*	0B	1	1	Issue Data to WUPPE
IDUI	*	0C	1	1	Issue Data to UIT
IDRS	*	0D	2	2	Issue Data to RAUS
SGMT	*	0E	1	1	Preset GMT
RGMT	*	0F	1	1	Read GMT
XPIT	*	10	1	1	Execute PCC Instruction Test
XPMT	*	11	1	1	Execute PCC Memory Test
XHRM	*	12	1	1	Execute PCC HRM Output
XTPT		13	1	1	Execute Throughput Test
SSPR		14	1	1	Set Pulse Synchronous Read
XINT		15	1	1	Execute IMCE Initialization

4.4.1 EXECUTE IMCE INSTRUCTION TEST

Upon receipt of the Execute IMCE Instruction Test Command message, the IMCE processor will send an acknowledge message and then will perform a predefined set of instructions that verify the operational status of the processor.

The instruction test will verify the operation of the arithmetic (add, subtract, multiply, divide), logical (or, and, not, exclusive or), control (jump, loop), string (move, scan, compare), compare (compare), and register-memory (move). The instruction test will verify base register, index register, segment register, and absolute addressing modes. The floating point and intrinsic functions will be verified.

Upon successful completion of the instruction test, the IMCE will send a test complete response message. If during test execution an error condition occurs, the IMCE will send a test error response message containing information for analysis of the error condition; e.g., address, registers, data, test sequence number, etc. The IMCE processor will terminate the Instruction Test on its first detected error.

Command Mnemonic and Code:

XIIT 01

Command Data Parameters:

None

Default Values:

None

Command Message Format (1):

7000 1303 0002 0001

Response Message Format (1):

```
1281 001F ssss dddd ... dddd
               (1)      (29)

      ssss = IMCE Status Code

             --00  Test Successful
             --01  Test Error

      dddd (1) =  0000 Test Error Condition

      nnmm   First byte is the test number (nn)
             Second byte is the failure code (mm):
      01mm   Integer Arithmetic Failure
      02mm   Logical Operation Failure
      03mm   Control Operation Failure
      04mm   Compare Operation Failure
      05mm   Floating Point Arithmetic Failure
```

Verification:

PDSS/IMC will test the IMCE Reply code [dddd(1)] to determine success of IMCE Instruction Test.

4.4.2 EXECUTE IMCE MEMORY TEST

Upon receipt of the Execute IMCE Memory Test Command Message, the IMCE processor will send an acknowledge message and then the IMCE processor will perform a predefined memory test which verifies that each memory segment can be read or written.

Upon successful completion of the memory test, the IMCE will send a test complete response message. If during test execution an error condition occurs, the IMCE will send a test error response message containing information for analysis of the error condition; e.g., address, registers, data, test sequence number, etc.

Command Mnemonic and Code:

XIMT 02

Command Data Parameters:

None

Default Values:

None

Command Message Format (1):

F000 1303 0002 0002

Response Message Format (1):

```
1281 0007 ssss dddd ... dddd
               (1)      (5)

      ssss = IMCE Status code

             --00  Test Successful
             --01  Test Error

      dddd(1) < > 0000  Test Error Condition
```

nnmm First byte is the number of cycles into the memory test at which the memory error was detected.
Second byte is either 1 for PROM or 3 for RAM.

dddd(2),dddd(3)

The next two words are the address of the memory location at which the error was detected. (physical address)

dddd(4),dddd(5)

The next two words contain the actual data read and the data expected.

Verification:

The PDSS/IMC will test the IMCE Reply code [dddd(1)] to determine success of IMCE Memory Test.

4.4.3 RETURN RAUI DATA

The Return RAUI Data function will be performed in the following sequence.

1. PDSS/IMC sends Return RAUI Data Command Message to IMCE.
2. IMCE sends Acknowledge Message
3. PDSS/IMC sends test pattern to SEID PCM Serial Channel.
4. IMCE reads RAUI Serial Channel
5. IMCE sends Return RAUI Data Response Messages to PDSS/IMC.

Command Mnemonic and Code:

RDRI 03

Command Data Parameters:

32 Serial Output Data Words

```
dddd,dddd,...,dddd
(1)  (2)      (32)
```

Default Values:

```
FAF5, 1111, 2222, 3333, 4444, 5555, 6666, 7777,
8888, 9999, AAAA, BBBB, CCCC, DDDD, EEEE, FFFF,
0000, 0123, 4567, 89AB, CDEF, FEDC, BA98, 7654,
3210, 0011, 2233, 4455, 6677, 8899, AABB, CCDD
```

Command Message Format (1):

F000 1303 0002 0003

Response Message Format (2):

```
1281 001F ssss dddd ... dddd
               (1)      (29)

1281 0005 ssss dddd dddd dddd
               (30) (31) (32)
```

ssss = IMCE Status Word

--00 Read Successful
--01 Unable to read RAUI

dddd's = RAUI Data Words (1)...(32)

Verification:

PDSS/IMC will compare data returned from IMCE to data output on RAUI channel. All AI's, DI's, and RAUI interfaces will be monitored to verify no other changes occurred.

4.4.4 READ DISCRETE INPUTS

PDSS/IMC will set the SEID's 24 DO's that interface to IMCE's DIO card to a user defined or predefined default state. The IMCE processor will be sent the command instructing it to read the DIO card DI's. The IMCE processor will read all DIO DI's and will return the states in the response message to PDSS/IMC. Each DI channel state will be represented by a 16 bit word where 0000H = OFF and 0001H = ON.

Command Mnemonic and Code:

```
RDIS   04
```

Command Data Parameters:

```
24 DO'S

dddd,...,dddd
(1)      (24)

dddd = 0 for OFF
     = 1 for ON
```

Default Values:

```
0,  0, ..., 0          (OFF STATE)
(1) (2)     (24)
```

Command Message Format (1):

```
F000 1303 0002 0004
```

Response Message Format (1):

```
1281 001A ssss dddd ... dddd
               (1)      (24)

       ssss = IMCE Status Code

              -000  Test OK
              -001  Unable to Read Discrete Inputs

       dddd's = discrete input value

                0000 = OFF
                0001 = ON
```

```
d ( 1... 4) = DIO ( 13... 16)
d ( 5...16) = DIO (101...112)
d (17...20) = DIO (212...216)
d (21...24) = DIO (313...316)
```

Data words 1 to 4 will contain the DIO Discrete Channels 0,13 to 0,16 (see Table 2-2); data words 5 to 16 will contain Discrete Channels 1,1 to 1,12; words 17 to 20 will contain Discrete Channels 2,12 to 2,16 and words 21 to 24 will contain Discrete Channels 3,13 to 3,16.

Verification:

PDSS/IMC will compare the DI states returned by the IMCE processor with the DO's set. Incorrect values will be displayed to the data monitor.

4.4.5 READ ANALOG INPUTS

PDSS/IMC will set user or predefined default Analog Output (AO) values. The IMCE processor will then be instructed to read Analog Inputs (AI's). The Analog Input values will be returned in the response message.

Command Mnemonic and Code:

```
RALG   05
```

Command Data Parameters:

```
dddd, ..., dddd
(1)        (32)
```

Default Values:

```
dddd(1...32) = 3FFF     (+2.5V)
```

Command Message Format (1):

```
F000 1303 0002 0005
```

Response Message Format (2):

```
1281 001F ssss dddd ... dddd
               (1)      (29)

1281 0005 ssss dddd ... dddd
               (30)     (32)

       ssss = IMCE Status Code

              -000  Test Successful
              -001  Unable to Read AI

       dddd's = AI's
```

Each AI data value will be two's complement, left justified with twelve data bits contained in the system bit data word.

Verification:

The values of the AI's read by IMCE will be compared with the AO values set by PDSS/IMC. Incorrect values will be displayed to the data monitor. AI values returned by IMCE will be compared AO values set and verified to be within two bits. AI, DI, RAUI, and RIUI interfaces will be read and compared with last state to verify no other changes occurred.

4.4.6 READ RATE INPUTS

The Read Rate Inputs command will be performed in the following sequence.

1. PDSS/IMC sets GYROS Pulse Registers.
2. PDSS/IMC waits until pulse stream is complete.
3. PDSS/IMC sends Read Rate Inputs Command message to IMCE.
4. IMCE sends Acknowledge Message.
5. IMCE buffers accumulated pulses and clears accumulation values.
6. IMCE sends buffered accumulated pulse values in Response Message to PDSS/IMC.
7. PDSS/IMC sends Acknowledge Message.

PDSS/IMC will set pulse rates and duration in the simulation hardware. Upon completion of the pulsing activity by the GYRO card, PDSS/IMC will send a request to IMCE to read accumulated pulses. The IMCE processor will reply to PDSS/IMC with a count of pulses accumulated for all twelve channels.

The IMCE processor will reset to zero the accumulated pulses when RATE READ Input command function has been performed and the response message transfer initiated.

Command Mnemonic and Code:

RGYR 06

Command Data Parameters:

```
dddd, dddd, ..., dddd
(1)   (2)        (24)
```

```
dddd( 1, 2) = Channel 1
dddd( 3, 4) = Channel 1
dddd( 5, 6) = Channel 2
dddd( 7, 8) = Channel 2
dddd( 9,10) = Channel 3
dddd(11,12) = Channel 3
dddd(13,14) = Channel 4
dddd(15,16) = Channel 4
dddd(17,18) = Channel 5
dddd(19,20) = Channel 5
dddd(21,22) = Channel 6
dddd(23,24) = Channel 6

      dddd(i,j)
         i = Total Pulses (Unsigned Integer)
         j = Pulse Rate + Direction (Sign
             Bit = Direction
             Pulse Rate = .01KHZ* Integer
```

Default Values:

7FFF, 4000, 7FFF, C000, 7FFF, 2000, 7FFF, A000,
0100, 0100, 0100, 8010, 0100, 8100, 0100, 0100,
0400, 1000, 0400, 9000, 0400, 9000, 0400, 1000

Channel	Number of Counts		Rate	
1	7FFFH	32767	4000H	+163.84KHZ
1	7FFFH	32767	C000H	-163.84KHZ
2	7FFFH	32767	2000H	+81.92KHZ
2	7FFFH	256	A000H	-81.92KHZ
3	0100H	256	0100H	+2.56KHZ
3	0100H	256	8010H	-2.56KHZ
4	0100H	256	8100H	-2.56KHZ
4	0100H	·256	0100H	+2.56KHZ
5	0400H	1024	1000H	+40.96KHZ
5	0400H	1024	9000H	-40.96KHZ
6	0400H	1024	9000H	-40.96KHZ
6	0400H	1024	1000H	+40.96KHZ

Command Message Format (1):

F000 1303 0002 0006

Response Message Format (1):

```
1281 001A ssss dddd ... dddd
                (1)     (24)
```

```
ssss          = IMCE Status Code

                -000  Test Successful
                -001  Unable to Read DRIRU

dddd( i, j) = 32 Bit Accumulated Rate
dddd( 1, 2) = Accumulate + Rate for Channel 1
dddd( 3, 4) = Accumulate + Rate for Channel 1
dddd( 5, 6) = Accumulate + Rate for Channel 2
dddd( 7, 8) = Accumulate + Rate for Channel 2
dddd( 9,10) = Accumulate + Rate for Channel 3
dddd(11,12) = Accumulate + Rate for Channel 3
dddd(13,14) = Accumulate + Rate for Channel 4
dddd(15,16) = Accumulate + Rate for Channel 4
dddd(17,18) = Accumulate + Rate for Channel 5
dddd(19,20) = Accumulate + Rate for Channel 5
dddd(21,22) = Accumulate + Rate for Channel 6
dddd(23,24) = Accumulate + Rate for Channel 6
```

Verification:

PDSS/IMC will compare the values read with the number of pulses issued by the simulation hardware. Incorrect values will be displayed to the data monitor.

4.4.7 READ RAUS INPUT

PDSS/IMC will issue a user defined or predefined default data stream to the RAUI. The IMCE processor will be instructed to read data on its RAUS interface. The IMCE processor will reply to PDSS/IMC with the data read.

Command Mnemonic and Code:

RDRS 07

Command Data Parameters:

32 Words Data Value

Default Values:

0001, FFFE, 0003, FFFC, 0005, FFFA, 0007, FFF8,
0009, FFF6, 000B, FFF4, 000D, FFF2, 000F, FFF0,
1111, 2222, 3333, 4444, 5555, 6666, 7777, 8888,
9999, AAAA, BBBB, CCCC, DDDD, EEEE, FFFF, 0000

Command Message Format (1):

F000 1303 0002 0007

Response Message Format (2):

```
1281, 001F, ssss, dddd ... dddd
                  (1)      (29)

1281, 0005, ssss, dddd ... dddd
                  (30)     (32)
```

ssss = IMCE Status

-000 Test Successful
-001 Unable to Read RAU Input

```
dddd ... dddd = data read
(1)      (32)
```

Verification:

PDSS/IMC will compare the data read with the data issued on the RAUI. Incorrect values will be displayed to the data monitor. Data issued to RAUI will be compared with data read and returned from RAUS by IMCE. AI, DI, and RIUI interfaces will be read and compared with last state to verify no changes occurred.

4.4.8 ISSUE DISCRETE OUT TO "ON"

PDSS/IMC will issue a command to the IMCE processor instructing it to issue a user predefined pattern of Discrete Outs to ON. IMCE will issue the discrete outs sequentially with no time delays between outputs except nominal processing time.

Command Mnemonic and code:

```
ISON   08
```

Command Data Parameters:

1 To 40 IMCE Discrete Output Channel No's

```
dddd, ..., dddd
(1)        (20)

dddd = xxyy  xx & yy = DO Channel #
                            or
                       = 'FF' Last Entry
```

Default Values:

0102, 0304, 4142, 4344, 4546, 4748, 494A, 4B4C, 4D4E, 4FFF

See Table 2-2 for channel definitions.

Command Message Format (1):

```
F000 1303 0006 0008 xxyy .... xxyy
                    (1)       (20)
```

Response Message Format (1):

```
1281 0016 ssss xxyy ... xxyy
               (1)      (20)

       ssss = IMCE Status Code

              -000  Test Successful
              -001  Time Out on Discrete Output

       xxyy(i) = Same as Command Message
```

Verification:

PDSS/IMC will compare the Discrete Inputs with the pattern to be issued by IMCE. Incorrect values will be displayed to the data monitor. All DI channels will be read to verify that IMCE turned on correct channels with others remaining unchanged. AI, RAUI, and RIUI interfaces will be read and compared with the last state to verify no other changes occurred.

4.4.9 ISSUE DISCRETE OUT TO "OFF"

PDSS/IMC will issue a command to the IMCE processor instructing it to issue a user or predefined pattern of discretes to OFF. IMCE will issue the discrete outs sequentially with no time delays between outputs except nominal processing time.

Command Mnemonics and Code:

ISOF 09

Command Data Parameters:

40 Discrete Input Channel No's

```
dddd, ..., dddd
(1)        (20)
```

dddd = xxyy xx & yy = Channel No's

Default Values:

0102, 0304, 4142, 4344, 4546, 4748, 494A, 4B4C, 4D4E, 4FFF

See Table 2-2 for channel definitions.

Command Message Format (1):

```
F000 1303 0006 0009 xxyy ... xxyy
                    (1)      (20)
```

Response Message Format (1):

```
1281 0016 ssss xxyy ... xxyy
               (1)      (20)
```

ssss = IMCE Status Code

-000 Test Successful
-001 Time Out on Discrete Output

xxyy(i) = DO Channel No's

Verification:

PDSS/IMC will compare the Discrete Inputs with the pattern to be issued by IMCE. Incorrect values will be displayed to the data monitor. All DI's will be read to verify that IMCE turned off correct channels with others remaining unchanged. AI, RAUI and RIUI interfaces will be read and compared to the last state to verify no other changes occurred.

4.4.10 ISSUE DISCRETE OUT

PDSS/IMC will send to the IMCE processor a command with user or predefined patterns containing Discrete Out channel numbers, and output states to be issued by IMCE. IMCE will issue the discrete outs sequentially with no time delays between outputs except nominal processing time except where a specific delay is requested.

Command Mnemonic and Code:

ISOT 0A

Command Data Parameters:

1 To 28 Channel No's and States or Time Delays

```
ccxx, ..., ccxx
(1)        (28)

cc = Channel No.      xx = State  00 = OFF
                                  01 = ON
   = 'F0' Time Delay  xx = Delay Time
                         (xx* 100 Milliseconds)
   = 'FF' Last Item
```

Default Values:

None

Command Message Format (1):

```
F000 1303 001E 000A ccxx ...  ccxx
                    (1)       (28)
```

Response Message Format (1):

```
1281 001E ssss  ccxx ... ccxx
                (1)      (28)
```

ssss = IMCE Status Code

Verification:

PDSS/IMC will compare Discrete Inputs with the pattern to be issued verifying that the correct operation was performed. Incorrect values will be displayed to the data monitor. All DI's will be read to verify the correct operation took place on the indicated channels with the remaining channels unchanged. AI, RAUI, and RIUI interfaces will be read to verify that no other changes occurred.

4.4.11 ISSUE DATA TO WUPPE

Upon receipt of the Issue Data to WUPPE Command Message, the IMCE processor will transmit to the WUPPE interface a serial command. The serial command will be transmitted at a 50 HZ rate (i.e., every 20 milliseconds). The operator will specify the duration of the WUPPE transmission.

The operator will specify a hex data pattern and an increment data pattern. IMCE will compute a new serial data word for each transmission by adding the increment data pattern to the previous pattern.

Upon completion, the IMCE will send a response message containing the IMCE status code, the original data, and the last transmitted value to WUPPE.

Command Mnemonic and Code:

IDWP 0B

Command Data Parameters:

count, initial data, increment value

bbbb,dddd,aaaa

Default Values:

0032,0000,0101
Count = 50
Initial data = 0000H
Increment Value = 0101H

Command Message Format (1):

F000 1303 0005 000B bbbb dddd aaaa

bbbb = count of times to output
dddd = initial data pattern
aaaa = increment data pattern

Response Message Format (1):

1281 0006 ssss bbbb dddd aaaa ffff

ssss = IMCE Status Code

-000 Test Successful
-001 WUPPE Overflow

bbbb = count of times to output
dddd = initial data pattern
aaaa = increment data pattern
ffff = final data pattern

Verification:

PDSS/IMC will monitor the WUPPE interface and collect the serial messages. The acquired WUPPE data will be compared to an expected value computed in a similar manner to IMCE. The WUPPE interface will be monitored to verify the data rate , will accumulate WUPPE data, and will compare with calculated PDSS/IMC data. The data will be compared with data as computed by PDSS/IMC. AI, DI, RAUI, and RIUI interfaces will be read and compared with last state to verify no changes occurred.

4.4.12 ISSUE DATA TO UIT

The IMCE processor will transmit to the UIT interface a serial command. The serial command will be transmitted at a 50 HZ rate (i.e., every 20 milliseconds). The operator will specify the duration of the UIT transmission.

The operator will specify a hex data pattern and an increment data pattern. IMCE will compute a new serial data word for each transmission by adding the increment data pattern to the previous pattern.

Upon completion, the IMCE will send a response message containing the IMCE status code, the original data, and the last transmitted value to UIT.

Command Mnemonic and Code:

IDUI 0C

Command Data Parameters:

count, initial data, increment value, initial data, increment value

bbbb,gggg,hhhh,iiii,jjjj

Default Values:

0032,0000,0101,0000,8080
Count = 50
Initial Data = 0000H
Increment Value = 0001H
Initial Data = 0000H
Increment Value = 8080H

Command Message Format (1):

F000 1303 0007 000C bbbb gggg hhhh iiii jjjj

bbbb = count of times to be output
gggg = initial data pattern for pitch
hhhh = increment data pattern for pitch
iiii = initial data pattern for yaw
jjjj = increment data pattern for yaw

Response Message Format (1):

1281 0009 ssss bbbb gggg hhhh iiii jjjj kkkk llll

ssss = IMCE Status Word

-000 = Test Successful
-0001 = UIT Overflow

bbbb = count of times to be output
gggg = initial data pattern for pitch
hhhh = increment data pattern for pitch
iiii = initial data pattern for yaw
jjjj = increment data pattern for yaw
kkkk = final data pattern for pitch
llll = final data pattern for yaw

Verification:

PDSS/IMC will monitor the UIT interface and collect the serial messages. The acquired UIT data will be compared to an expected value computed in a similar manner to IMCE. The UIT interface will be monitored to verify the data rate, will accumulate UIT data, and will compare with calculated PDSS/IMC data. The data will be compared with data as computed by PDSS/IMC. AI, DI, RAUI, and RIUI interfaces will be read and compared with the last state to verify no changes occurred.

4.4.13 ISSUE DATA TO RAUS

PDSS/IMC will send a data pattern (32 words) for the IMCE to issue to its RAUS. The data pattern is specifiable by the operator.

After issuing the data to the RAUS, IMCE will send response messages containing the IMCE response code and the PDSS/IMC RAUS data as received.

Command Mnemonics and Code:

```
IDRS   0D
```

Command Data Parameters:

```
32 Serial Data Values

dddd, ..., dddd
(1)        (32)
```

Default Values:

```
0001, FFFE, 0003, FFFC, 0005, FFFA, 0007, FFF8,
0009, FFF6, 000B, FFF4, 000D, FFF2, 000F, FFF0,
1111, 2222, 3333, 4444, 5555, 6666, 7777, 8888,
9999, AAAA, BBBB, CCCC, DDDD, EEEE, FFFF, 0000
```

Command Message Format (2):

```
F000 1303 001E 000D dddd .... dddd
                    (1)       (28)

F000 1303 0006 000D dddd .... dddd
                    (29)      (32)

          dddd(1...32) = RAUS Data
```

Response Message Format (2):

```
1281 001F ssss dddd ... dddd
               (1)      (29)
```

```
1281 0005 ssss dddd ... dddd
               (30)     (32)

      ssss = IMCE Status Code

             -000  Test Successful
             -001  Time Out RAUS Write

      dddd(1...32) = RAUS Data Issued
```

Verification:

PDSS/IMC will read the RAUI interface and compare the data to the RAUS data sent to IMCE. AI, DI, and RIUI interfaces will be read and compared with the last state to verify no changes occurred.

4.4.14 PRESET GMT

The operator will specify a GMT value to which the IMCE will preset the TMI GMT clock. After receipt of the acknowledge, PDSS/IMC will preset the SEID GMT to the same value. The GMT data value will be specified in the DEP Services format; word 1 contains day of year (0 to 356) and words 2 and 3 contain number of elapsed milliseconds of day. The words are right justified.

Command Menmonic and Code:

PGMT 0E

Command Data Parameters:

Preset GMT Value

```
dddd, dddd, dddd
(1)   (2)   (3)
    dddd(  1) = day (0 to 365)
    dddd(2,3) = millisecond of day
                (right justified)
                (0 to 86,400,000)
```

Default Values:

0000, 0000, 0000

Command Message Format (1):

F000 1303 0005 000E dddd dddd dddd

dddd's = GMT

Response Message Format (1):

1281 0005 ssss dddd dddd dddd

ssss = IMCE Status Code

-000 Test Successful
-001 Invalid GMT
-002 TMI Error

dddd = GMT (Same as Command Data Parameters)

Verification:

PDSS/IMC will issue the read GMT command to IMCE and compare value returned with GMT read from SEID. The AI,DI, RAUI, and RIUI interfaces will be read and compared with the last state to verify no changes occurred.

4.4.15 READ GMT

The IMCE will read the TMI GMT and return the GMT value to PDSS/IMC.

Command Mnemonics and Code:

RGMT OF

Command Data Parameters:

None

Default Values:

None

Command Message Format (1):

F000 1303 0002 000F

Response Message Format (1):

1281 0005 ssss dddd dddd dddd

ssss = IMCE Status Code

-000 Test Successful
-001 TMI Error
-002 Time Read Invalid

dddd's = GMT

Verification:

PDSS/IMC will read the SEID GMT and compare the SEID GMT to the IMCE GMT. If the times differ by 10 milliseconds, an error condition is noted. AI, DI, RAUI, and RIUI interfaces will be read and compared with the last state to verify no changes occurred.

4.4.16 EXECUTE PCC INSTRUCTION TEST

Upon receipt of the Execute PCC Instruction Test command Message, the IMCE will invoke the PCC Instruction Test. Upon completion of the test, IMCE will send a response message to PDSS/IMC containing a test status and any data for the PCC Instruction Test.

Command Mnemonic and Code:

XPIT 10

Command Data Parameters:

None

Default Values:

None

Command Message Format (1):

F000 1303 0002 0010

Response Message Format (1):

```
1281 001F ssss dddd ... dddd
               (1)      (29)
```

ssss = IMCE Status

-000 Test Successful
-001 Test Error

dddd(1...29) = IMCE Defined Data

Verification:

PDSS/IMC will test the IMCE Status Code to determine the success of PCC Instruction Test.

4.4.17 EXECUTE PCC MEMORY TEST

Upon receipt of the Execute PCC Memory Test Command Message, the IMCE invokes the PCC Memory Test. Upon completion of the test, IMCE will send a response message to PDSS/IMC containing a test status and any data for the PCC Memory Test.

Command Mnemonic and code:

XPMT 11

Command Data Parameters:

None

Default Values:

None

Command Message Format (1):

F000 1303 0002 0011

Response Message Format (1):

```
1281 001F ssss dddd ... dddd
               (1)      (29)
```

ssss = IMCE Status Code

-000 Test Successful
-001 Test Error

dddd(1...29) = IMCE Defined Data

Verification:

PDSS/IMC will test the IMCE Status Code to determine the success of PCC Memory Test.

4.4.18 EXECUTE PCC HRM OUTPUT

When the command message is received, the IMCE will send a command to PCC to start or stop the PCC HRM Output.

Command Mnemonic and Code:

XHRM 12

Command Data Parameters:

N/A

Default Values:

N/A

Command Message Format (1):

F000 1303 0003 0012 dddd

dddd = Command to Start/Stop

0000 = Stop
0001 = Start

Response Message Format (1):

1281 0003 ssss dddd

ssss = IMCE Status Code

-000 Test Successful
-001 Test Error

dddd = Command to Start/Stop

Verification:

PDSS/IMC will test the IMCE Status code to determine the success of the Execute PCC HRM output command. PDSS/IMC will notify the operator when PCC HRM Output has been started.

4.4.19 EXECUTE THROUGHPUT TEST

The PDSS/IMC and IMCE Throughput Test will initiate a predetermined Input/Output traffic model. PDSS/IMC and IMCE will remain in the throughput test until commanded to stop. Table 4-3 defines the throughput test traffic model. During the execution of the throughput tests, the only commands that will be accepted by PDSS/IMC are commands for control of the log or displays.

Command Mnemonic and Code:

XTPT 13

Command Data Parameters:

dddd

dddd = start/stop indicator

0000 = STOP
0001 = START

Default Values:

See Table 4-3

Command Message Format (1):

F000 1303 0003 0013 dddd

Response Message Format (1):

1281 0003 ssss dddd

ssss = IMCE Status Word

Verification:

No data verification will be performed by PDSS/IMC during the throughput test.

TABLE 4-3: THROUGHPUT TEST DATA

IMCE

1/250 MILLISECONDS	DO'S (1 DO CHANGE PER 250MS) RIPPLING '1' THEN '0'
	AO'S (1 AO CHANGE PER 250MS) -5V, 0V, +5V
	DI'S AND AI'S (SAMPLE)
1/SECOND	RAUS - 1 SERIAL MESSAGE INC. DATA
	RAUI - 1 SERIAL MESSAGE
50HZ	DEI/RIUI INCREMENTING DATA
1/250 MILLISECONDS	DEI/GYROS ACCUMULATE

PDSS/IMC

1/250 MILLISECONDS	DO'S (1 DO CHANGE PER 250MS) RIPPLING '1' THEN '0'
	AO'S (1AO CHANGE PER 250 MS) -5V, 0V, +5V
1/SECOND	ACQUIRE AND RESPOND TO RAUS AND RAUI SERIAL
PULSE 5/SECOND	+/- PULSE FOR ALL CHANNELS
50HZ	ACQUIRE DRIRU

4.4.20 SET PULSE SYNCHRONOUS READ

The Set Pulse Synchronous read command starts or stops the IMCE synchronous read of pulse rate inputs. When active, IMCE will read the rate inputs at a minimum rate of 250 milliseconds.

Command Mnemonic and Code:

SPSR 14

Command Data Parameter:

dddd

dddd = Inhibit/Active

0000 = Inhibit
0001 = Active

Default Values:

N/A

Command Message Format (1):

F000 1303 0003 0014 dddd

Response Message Format (1):

1281 0003 ssss dddd

ssss = IMCE Status Word
dddd = Inhibit/Active Indicator

0000 = Inhibit
0001 = Active

Verification:

None.

4.4.21 EXECUTE IMCE INITIALIZATION

Upon receipt of the Execute IMCE Initialization command, the IMCE processor will re-initialize its output interface to the same state as the power up state. This command is a "warm" restart for IMCE.

Command Mnemonic and Code:

XINT 15

Command Data Parameter:

None

Default Values:

None

Command Message Format (1):

F000 1303 0002 0015

Response Message Format (1):

1281 002 ssss

ssss = IMCE Status Word

4.5 PDSS/IMC QUALIFICATION TEST SOFTWARE DISPLAYS

PDSS/IMC will provide an operator tutorial display and a test summary display. The PDSS/IMC operator tutorial display will be displayed on the PDSS master console CRT. The test summary display will be displayed to the memory mapped display monitor.

The operator tutorial display will be displayed continuously on the master console CRT. The display will contain a summary of the operator commands. The last two lines on the CRT display are reserved for prompts, data entry, and operator message. Figure 4-4 depicts the Operator Tutorial Display.

The test summary display will contain the following information. A status line for each of the IMCE functions will be maintained. This status line contains a count of the number of passes, a count of IMCE detected failures, a count of IMCE failures to respond or acknowledge, a count of PDSS/IMC comparison failures, and the last failure data values.

The counters and data values for this display will be re-initialized by an operator command.

The display page will contain the last data values for the command messages and response messages. Acknowledge messages are not displayed.

The test summary display will contain indicators (reverse-black on white) for program modes and status. The Log status will be indicated as ON or OFF. The program mode will be

indicated as SINGLE or SEQUENCE. The test step status will be indicated as COMMAND, C-ACK, RESPONSE, R-ACK, or COMPLETE.

For all modes, the command being executed will be indicated.

Figure 4-5 depicts the Test Summary Display page.

PDSS/IMC COMMAND

XIIT	Execute IMCE Inst. Test	XIMT	Execute IMCE Memory Test
RDRI	Read Data RAUI	RDIS	Read Discretes
RALG	Read Analogs	RGYR	Read Rate from Gyro
RDRS	Read Data RAUS	ISON	Issue Discrete ON
ISOF	Issue Discrete OFF	ISOT	Issue Discrete Out
IDWP	Issue Data to WUPPE	IDUI	Issue Data to UIT
IDRS	Issue Data to RAUS	SGMT	Set GMT
RGMT	Read GMT	XPIT	Execute PCC Inst. Test
XPMT	Execute PCC Memory Test	XHRM	Execute HRM Output
XTPT	Execute Throughput Test	SSPR	Set Pulse Synchronous Read
XINT	Execute IMCE Initialize		

VIEW	View Memory	TMC	Timed Measurement Command
LOG	Log ON	NLOG	Log OFF
STOP	Stop	DISP	Select Display
RED	Pause/Resume	PMEM	Print Memory
PLOG	Print Log	BLUE	Single Step
COMM	Log Comment	SRST	System Reset
STAR	Start	TASK	Task Select
PIO	Perform I/O	MOD	Modify Memory

FIGURE 4-4: OPERATOR TUTORIAL DISPLAY

TEST	#PASSES	#FAILS	LAST FAILURE DATA VALUES	<TYPE>
+01 XIIT	-------	-------	---- ---- ---- ----	+SNG
02 XIMT				SEQ
03 RDRI				
04 RDIS				
05 RALG				<LOG>
06 RGYR				+ON
07 RDRS				OFF
08 ISON				
09 ISOF				<STEP>
0A ISOT				+CMD
0B IDWP				ACK
0C IDUI				RSP
0D IDRA				ACK
0E IDRA				END
0F RGMI				<MODE>
10 XPHT				+SST
11 XPMT				+PSE
12 XHRM				
13 XTPT				
14 SSPR				
15 XINT				

COMMAND MSG:

RESPONSE MSG:

FIGURE 4-5: TEST SUMMARY PAGE

5.0 PDSS/IMC COMPUTER INTERFACE SIMULATION SOFTWARE

The PDSS/IMC Computer Interface Simulation software provides the capability for a real-time simulation of the orbital conditions that will occur at the IMC flight computer input-output interface. The major IMC external subsystems whose interfaces are to be simulated are:

- Dry Rotor Inertial Reference Unit (DRIRU-II)
- Advanced Star/Target Reference Optical Sensor (ASTROS)
- Ultra Violet Imaging Telescope (UIT)
- Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE)
- Spacelab Experiment Computer Operating System (SL-ECOS)
- Power Interface Subsystem

The PDSS/IMC Computer Interface Simulation software is to be designed to meet the following objectives.

Each Interface Simulation model will be designed to be self contained, thereby, allowing the model to be activated or deactivated by the operator without impacting the operation of the PDSS/IMC simulation. The independent simulations for each model will allow interconnection of actual flight equipment to the IMC flight computer rather than simulation models. PDSS/IMC will support hardware/hardware model substitution for all combinations of hardware and model connections.

The input and output data for each model will be implicitly defined. The input/output data rates will be modifiable by the operator during pretest preparation.

The Interface Simulation models will provide various data profiles that are selectable by real-time operator commands and/or model setup commands.

The PDSS/IMC Test Language will provide the capability for real-time query, control, and monitor of Interface simulations.

The PDSS/IMC simulation will be based on a resident data structure that contains information on each of the input/output ports. The data structure will contain the current data value for each port, the I/O command word, the data function, I/O activity, and supporting data. All data flow for the simulation models, logging, and display generators will be through the data structure.

To provide maximum flexibility for simulation of real-time data, the PDSS/IMC simulator will have the capability to accept simulated data from three sources: model generated data, timed data (file), or operator commanded data. Measurement data will be accepted from each of these three sources with a clearly defined priority scheme.

A PDSS/IMC Log function will provide the capability to log simulator data. The log function will be activated and deactivated by test operator commands. The logging rate of simulated data will be controlled by test operator commands with a maximum logging rate of once per second. Simulator data will be logged at a rate that is a multiple of 1 second ranging from 1 to 100 seconds. The log record will include a time tagged record of current input/output data. On an End-of-Medium indication, the logging function will close the log file and notify the operator that the log disk is full.

The PDSS/IMC will provide the capability to display simulator data on the memory mapped data monitor. A set of standard model display pages that present data relevant for that model will be predefined. The test operator will have the capability to request activation of a display page. Display data will be taken from the PDSS/IMC resident data structure. The system will provide the capability to construct new display pages.

To facilitate a dynamic and realistic mission simulation, the PDSS/IMC will provide a time and event ordered sequence of measurement commands that define a mission (test) profile. The mission profile will be generated from a set of many files which are merged by a pretest function into a single mission profile disk file. During real-time execution, PDSS/IMC will extract measurement commands from the disk file and execute those measurement commands.

5.1 PDSS/IMC MODEL DATA FLOW

PDSS/IMC will be designed to support the following capabilities:

- Master Measurement Data Base
- Timed Measurements
- Real Time Synchronous Data Acquisition and Output
- Real Time Asynchronous Data Acquisition and Output
- Measurement Validity Testing
- Command Interpreter
- PDSS ECOS/DDS Services for IMCE

Figures 5-1 and 5-2 depict the functional model layout for PDSS/IMC. Each of these elements will be defined in the following sections.

5.1.1 MASTER MEASUREMENT DATA BASE

PDSS/IMC will provide the support utilities for construction and maintenance of a Master Measurement Data Base (MMDB). The PDSS/IMC MMDB will be structured to be compatible to input medium and functional contents of the POCC Data Base for payload measurements.

The PDSS/IMC MMDB will contain at least the following information:

- Measurement Identifier
- Type (AO,DO,SO,AI,SI,DI)
- Description

- Calibration Data
- Range (Raw, Engineering Units)
- Sample Rate
- Format
- PDSS/IMC I/O Command (CNAF, SEID)
- PDSS/IMC Source/Destination
- PDSS/IMC Real Time Data Structure Index

The PDSS/IMC MMDB will provide the operator the capability to specify measurements by symbolic identifiers, specify calibration data, etc.

Figure 5-3 depicts the Master Measurement Data Base structure that will be the model for PDSS/IMC.

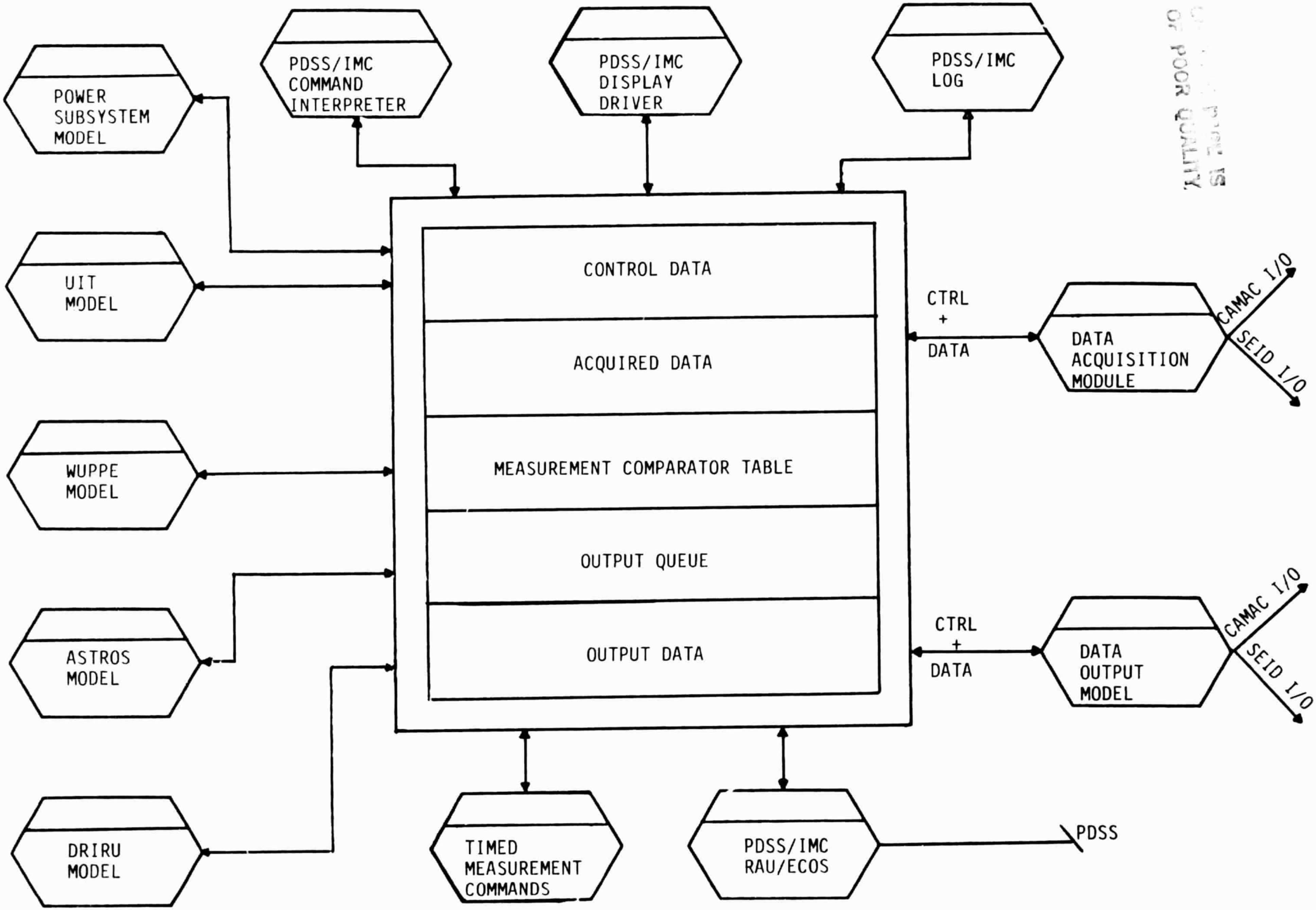


FIGURE 5-1: PDSS/IMC FUNCTIONAL MODEL LAYOUT

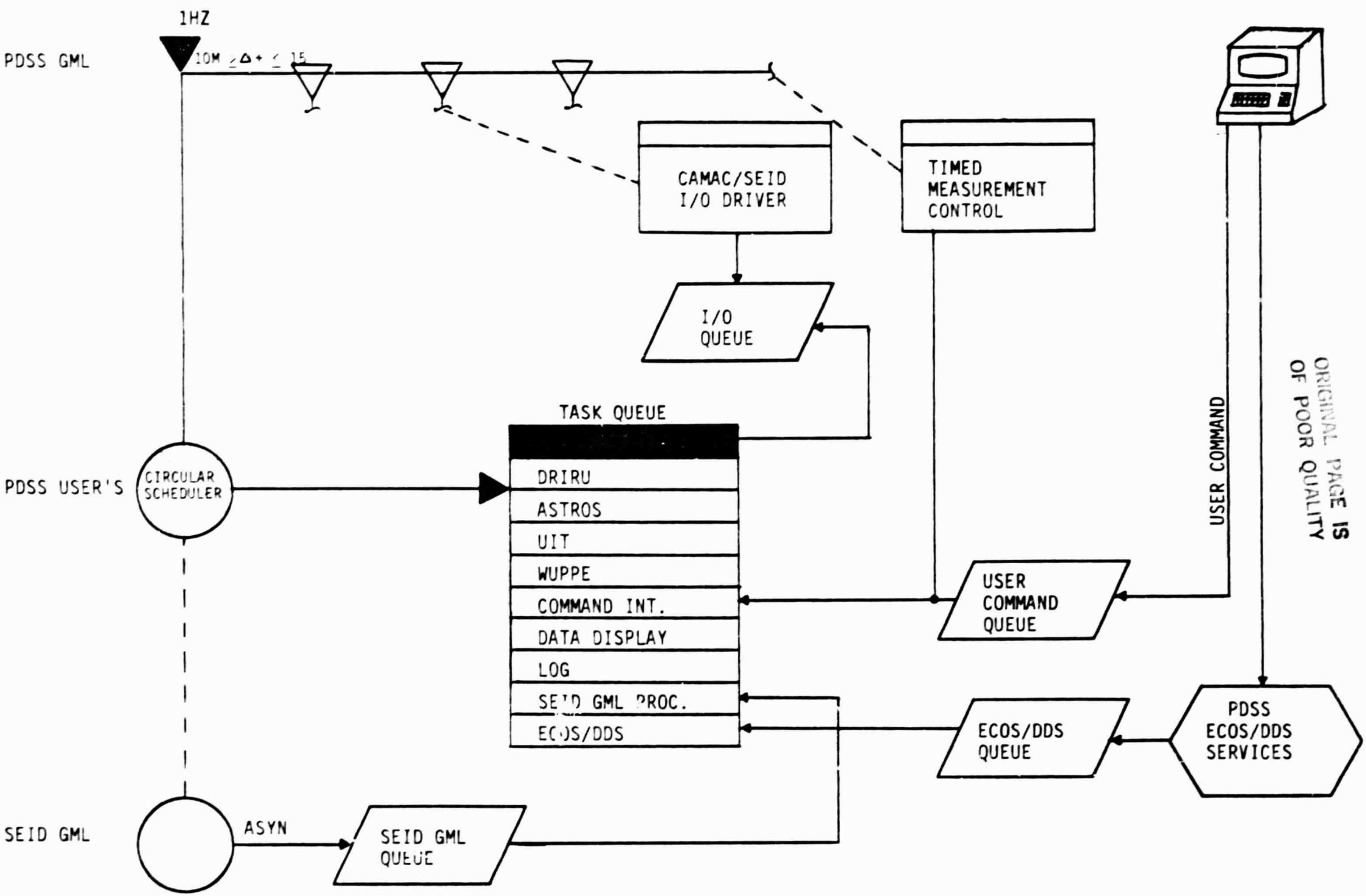


FIGURE 5-2: PDSS/IMC FUNCTIONAL FLOW

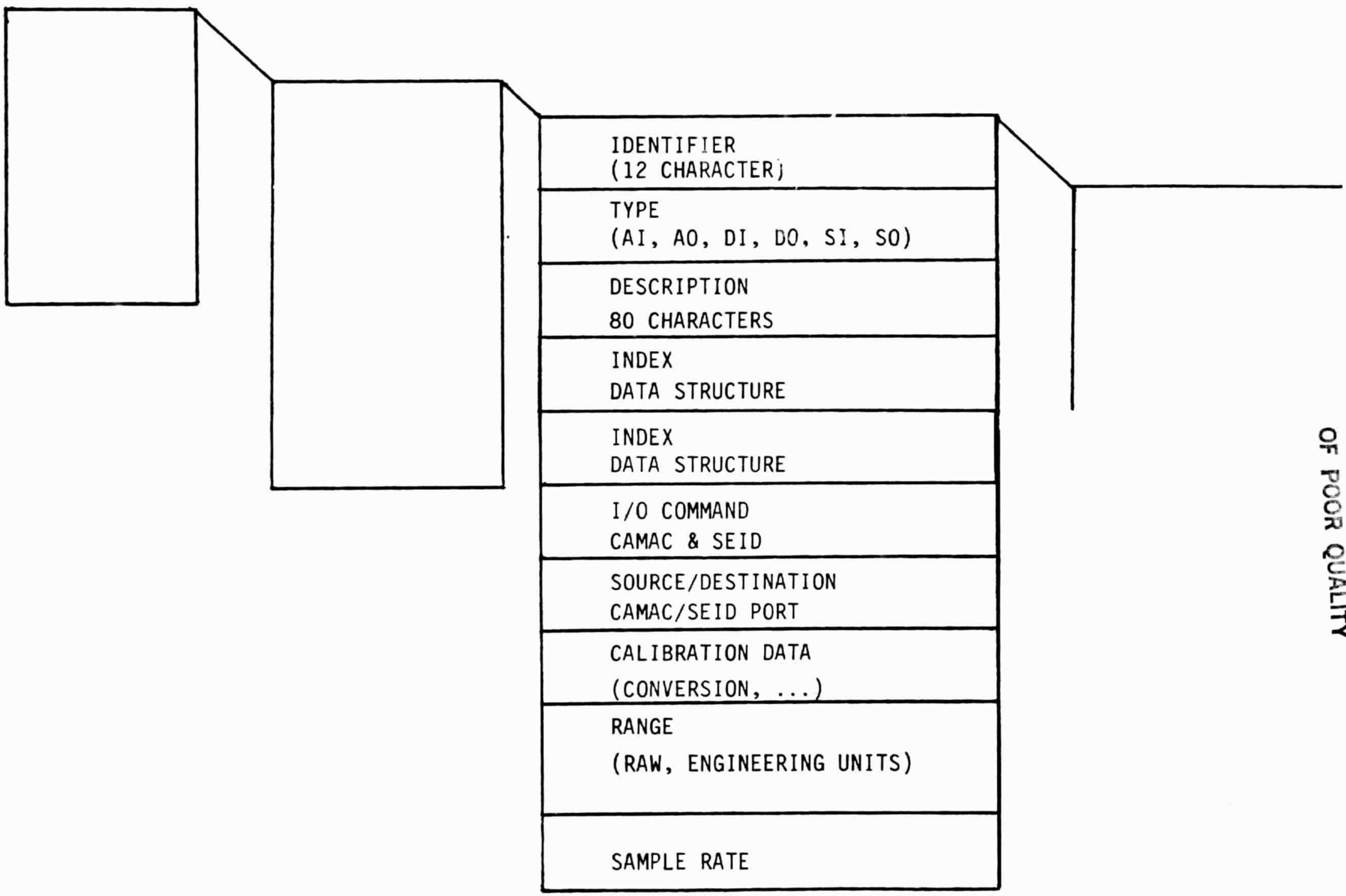


FIGURE 5-3: MEASUREMENT DATA BASE

5.1.2 REAL TIME DATA FLOW

To facilitate maximum flexibility and interface simplicity, the PDSS/IMC Computer Interface Simulation software will be designed to utilize a memory resident data structure for collecting, distributing and processing model data. This PDSS/IMC data structure will contain the following information:

- Current values for inputs (AI's, DI's, SI's)
- Current Values for outputs (AO's, DO's, SO's, Pulses)
- Function nodes and data for controlling outputs
- I/O activity events for controlling individual sensors
- Measurement Comparator Table for verifying measurement states

Figure 5-4 shows a relational type data structure that could be used by PDSS/IMC.

The Real Time Data Structure will allow data values for analogues and discretes to be output as determined by various data functions as described below.

F ( ) = X

This function sets a measurement output to a constant.

F ( ) = PULSE (INITIAL-VALUE, time 1, PULSE-VALUE time 2)

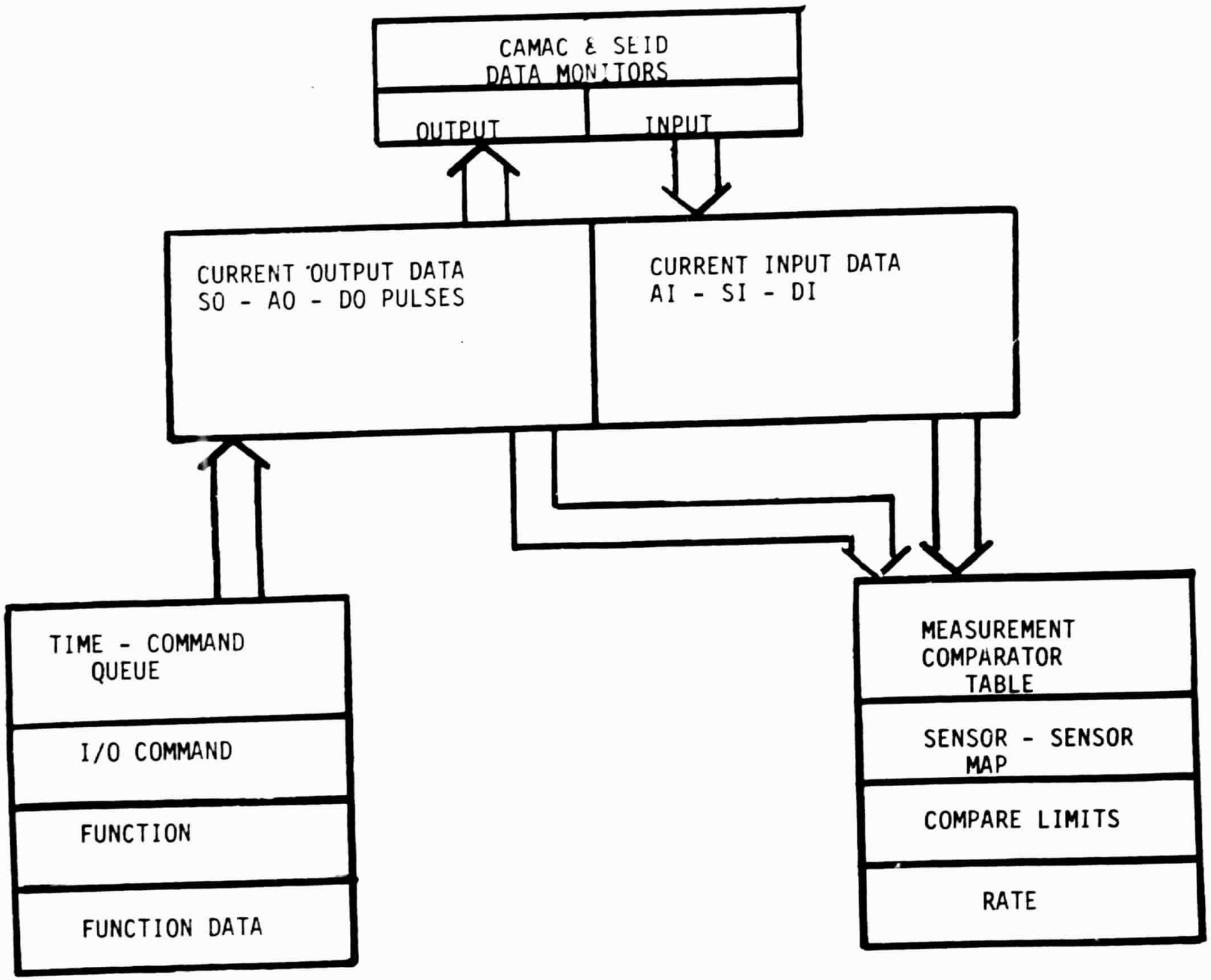


FIGURE 5-4: MEASUREMENT VERIFICATION

The PULSE function pulses a discrete or analog. The minimum time will be 100 milliseconds. The pulse logic will be:

```
SET Measurement to INITIAL-VALUE
DELAY time 1
SET Measurement to PULSE-VALUE
DELAY time 2
SET Measurement to INITIAL-VALUE
```

F ( ) = RAMP (INITIAL-VALUE, FINAL-VALUE, STEP-TIME, RESET-CONTROL)

The RAMP function will allow analog measuremnts to be ramped from an initial value to a ramp value and then ramped back or set directly to the initial value. The step width minimum time will be 20 milliseconds.

The pulse logic will be:

```
CALCULATE Step-width and # Steps
SET Measurement to INITIAL-VALUE
DO FOR #STEPS
    DELAY STEP-WIDTH
    INCREMENT Measurement by STEP-VALUE
    SET Measurement to new value
ENDDO
IF RETURN IS RAMP
  THEN:
    DO FOR #STEPS
      DELAY STEP-WIDTH
      DECREMENT Measurement by STEP-VALUE
      SET Measurement to new value
      ENDDO
```

```
    ELSE:
        DELAY STEP-WIDTH
        SET Measurement to INITIAL-VALUE
    ENDIF
```

F ( ) = TABLE (#ENTRIES, TIME, DATA,....)

The TABLE function will allow discrete or analog measurements to be set to a specified series of data values. The minimum time will be 100 milliseconds.

The TABLE logic will be:

```
DO FOR #ENTRIES
    SET measurement to DATA(i)
    DELAY TIME
ENDDO
```

The Real Time Data Structure will also contain a Measurement Comparator Table that coordinates measurement input to measurement output. This table will allow PDSS/IMC to verify correct measurement responses.

The Measurement Comparator Table will logically link IMCE and PDSS/IMC measurements for verification of signals. Table 5-1 defines the type data the Measurement Comparator Table will contain.

TABLE 5-1. MEASUREMENT COMPARATOR TABLE

PDSS/IMC:	AO	DO	SO	PULSE/O	AI	SI	RIUI
MCT:	f(AO,AI)	...					
IMCE:	AI	DI	SI	PULSE/I	AO	SO	RIU/O

5.2 PDSS/IMC DATA DISPLAY

PDSS/IMC will utilize the black/white memory mapped data console for displaying model particular data or overall system status data. Only one display will be active at a given time.

A Display Information File (DIF) will exist on disk for each display page. The DIF will contain background and foreground information for the Display Driver function. An offline utility function that allows the user to construct display pages and associated Display Information Files will be provided. These files will be resident on the PDSS/IMC disk and are accessable by the display driver function.

Once activated by a "=DISPLAY" command, the Display Driver will update the display page once per second. The display page will remain active until a new display page is commanded.

The user will have the capability to display measurement or sensors by Measurement Descriptive Name, Measurement ID (MSID), or Measurement Physical Address. The user will have the capability to display Discrete Inputs/Outputs as "0/1" or "OFF/ON".

Analog Inputs/Outputs could be displayable in hexadecimal values or decimal values. Serial Inputs/Outputs will be displayable as hexadecimal values.

Figure 5-5 to 5-11 will be the display pages for the identified model.

PDSS/IMC TIMELINE

GMT
COMMAND
GMT
COMMAND
.
.
.

GMT
COMMAND
.
.
.
GMT
COMMAND

FIGURE 5-5: PDSS/IMC TIMELINE

PDSS/IMC DATA STRUCTURE

FIGURE 5-6: PDSS/IMC DATA STRUCTURE

```
                 PDSS/IMC STATUS

MODELS                       POWER
   UIT      ON/OFF            +5V
   WUPPE                      +15V
   POWER                      -15V
   ASTROS                     TEMP
   DRIRU                      PWR ON/OFF
```

FIGURE 5-7: PDSS/IMC STATUS

UIT MODEL

MODEL ON/OFF RATE = -----

UIT DATA

XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

FIGURE 5-8: UIT MODEL

```
                    WUPPE MODEL

MODEL   ON/OFF                             RATE = -----

                 WUPPE PITCH DATA

  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

                 WUPPE YAW DATA

  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
  XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
```

FIGURE 5-9: WUPPE MODEL

```
                    DRIRU MODEL

MODEL ON/OFF

       COUNTS  RATE   ACCM

+DTXA  ------  -----  -----  RRH1A  ---  RSTX1A  ---
-DTXA                        RRH2A       RSTX2A
+DTXB                        RRL1A       RSTX1B
-DTXB                        RRL2A       RSTX2B
+DTYB                        RRH1B       RSTY1B
-DTYB                        RRH2B       RSTY2B
+DTYC                        RRL1B       RSTY1C
-DTYC                        RRL2B       RSTY2C
+DTZA                        RRH1C       RSTZ1A
-DTZA                        RRH2C       RSTZ2A
+DTZC                        RRL1C       RSTZ1C
-DTZC                        RRL2C       RSTZ2C

                             T/MA  -----  ANRXA  -----
                             T/MB         ANXRB
                             T/MC         ANRYB
                                          ANRYC
                                          ANRZA
                                          ANRZC
```

FIGURE 5-10: DRIRU MODEL

```
                    ASTROS MODEL

MODEL   ON/OFF

COMMAND:  XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX

RESPONSE: XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
          XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

A001 ----   A005 ----   A009 ----   A013 ----   FI01 ----
A002 ----   A006 ----   A010 ----   A014 ----   FI01 ----
A003 ----   A007 ----   A011 ----
A004 ----   A008 ----   A012 ----
```

FIGURE 5-11: ASTROS MODEL

5.3 PDSS/IMC INTERFACE DEFINITION

The following Table specifies the PDSS/IMC Interface definition.

The table identifies the measurement, source or sink for IMCE and PDSS/IMC GSE, the type measurement, and the corresponding physical address.

TABLE 5-2: PDSS/IMC INTERFACE DEFINITION

|ASTROS|	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
Cmd clock	RAUS	SOC	*	RAUI	SOC	*
Cmd data	RAUS	SO	*	RAUI	SO	N2
Data xfr rqst	RAUS	SIR	*	RAUI	SIR	*
Data clock	RAUS	SIC	*	RAUI	SIC	*
Serial data	RAUS	SI	*	RAUI	SI	N2
T/E cool pwr on/off	DIO	DO	001	SEID2	FI	16
Cover open/close	DIO	DO	002	SEID2	FI	17
Master reset	DIO	DO	003	SEID2	FI	18
CCD temp	A/D	AI	17	3112	AO	N9A0
Heat sink temp	A/D	AI	18	3112	AO	N9A1
Optics temp	A/D	AI	19	3112	AO	N9A2
EA temp	A/D	AI	20	3112	AO	N9A3
CCD coop pwr	A/D	AI	21	3112	AO	N9A4
Heat #1 pwr	A/D	AI	22	3112	AO	N9A5
Heat #2 pwr	A/D	AI	23	3112	AO	N9A6
Mstr Clk Status	A/D	AI	24	3112	AO	N9A7
+5v	A/D	AI	25	3112	AO	N10A0
+8v	A/D	AI	26	3112	AO	N10A1
+18v	A/D	AI	27	3112	AO	N10A2
-18v	A/D	AI	28	3112	AO	N10A3
Spare +6v	A/D	AI	29	3112	AO	N10A4
Spare	A/D	AI	30	3112	AO	N10A5

|DRIRU|	DEI	TYPE	ADDR	GSE	TYPE	ADDR
/* Incremental Angle Pulse Output */						
+DTXA	DEI	PULSE	*	GYROS	PULSE	N6
-DTXA	DEI	PULSE	*	GYROS	PULSE	N6
+DTXB	DEI	PULSE	*	GYROS	PULSE	N9
-DTXB	DEI	PULSE	*	GYROS	PULSE	N9
+DTYB	DEI	PULSE	*	GYROS	PULSE	N9
-DTYB	DEI	PULSE	*	GYROS	PULSE	N9
+DTYC	DEI	PULSE	*	GYROS	PULSE	N8
-DTYC	DEI	PULSE	*	GYROS	PULSE	N8
+DTZA	DEI	PULSE	*	GYROS	PULSE	N6
-DTZA	DEI	PULSE	*	GYROS	PULSE	N6
+DTZC	DEI	PULSE	*	GYROS	PULSE	N8
-DTXC	DEI	PULSE	*	GYROS	PULSE	N8

TABLE 5-2: PDSS/IMC INTERFACE DEFINITION
(CONTINUED)

/* Electrical Interface Mode Commands */

RRH1A	DEI	DO	*	SEID2	FI	00
RRH2A	DEI	DO	*	SEID2	FI	01
RRL1A	DEI	DO	*	SEID2	FI	02
RRL2A	DEI	DO	*	SEID2	FI	03
RRH1B	DEI	DO	*	SEID2	FI	04
RRH2B	DEI	DO	*	SEID2	FI	05
RRL1B	DEI	DO	*	SEID2	FI	06
RRL2B	DEI	DO	*	SEID2	FI	07
RRH1C	DEI	DO	*	SEID2	FI	08
RRH2C	DEI	DO	*	SEID2	FI	09
RRL1C	DEI	DO	*	SEID2	FI	10
RRL2C	DEI	DO	*	SEID2	FI	11

/* Range Status Telemetry Output */

RSTX1A	DIO	DI	101	SEID2	DO	00
Spare	DIO	DI	102	SEID2	DO	01
RSTX1B	DIO	DI	103	SEID2	DO	02
Spare	DIO	DI	104	SEID2	DO	03
RSTY1B	DIO	DI	105	SEID2	DO	04
Spare	DIO	DI	106	SEID2	DO	05
RSTY1C	DIO	DI	107	SIED2	DO	06
Spare	DIO	DI	108	SEID2	DO	07
RSTZ1A	DIO	DI	109	SEID2	DO	08
Spare	DIO	DI	110	SEID2	DO	09
RSTZ1C	DIO	DI	111	SEID2	DO	10
Spare	DIO	DI	112	SEID2	DO	11
TEMPA	A/D	AI	8	SW	RES	*
TEMPB	A/D	AI	9	SW	RES	*
TEMPC	A/D	AI	10	SW	RES	*

/* Analog Rate Telemetry Output */

ANRXA	A/D	AI	11	3112	AO	N12A2
ANRXB	A/D	AI	12	3112	AO	N12A3
ANRYB	A/D	AI	13	3112	AO	N12A4
ANRYC	A/D	AI	14	3112	AO	N12A5
ANRZA	A/D	AI	15	3112	AO	N12A6
ANRZC	A/D	AI	16	3112	AO	N12A7
T/MA	A/D	AI	5	3112	AO	N11A4
T/MB	A/D	AI	6	3112	AO	N11A5
T/MC	A/D	AI	7	3112	AO	N11A6

TABLE 5-2: PDSS/IMC INTERFACE DEFINITION (CONTINUED)

WUPPE	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
CLOCK	DEI	SER	*	RIUI	SER	*
DATA	DEI	SER	*	RIUI	SER	N3
ENABLE	DEI	DO	*	RIUI	DI	*

UIT	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
CLOCK	DEI	SER	*	RIUI	SER	*
DATA	DEI	SER	*	RIUI	SER	N4
XENABLE	DEI	DO	*	RIUI	DI	*
YENABLE	DEI	DO	*	RIUI	DI	*
XERR	A/D	AI	31	3112	AO	N10A6
YERR	A/D	AI	32	3112	AO	N10A7

RAUI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
Cmd clock	RAUI	SOC	*	SEID2	SOC	PCM CMD CLK 0
Cmd data	RAUI	SO	*	SEID2	SO	PCM DTA 0
Data xfr rqst	RAUI	SIR	*	SEID2	SIR	PCM DTA REQ 0
Data clock	RAUI	SIC	*	SEID2	SIC	PCM DTA CLK 0
Serial data	RAUI	SI	*	SEID2	SI	PCM DTA 0
Error	RAUI	ERR	*	SEID2	FI	97

TMI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
TIME	TMI	UTC	*	SEID2	UTC	UTC 1
TIME UPDATE	TMI	UTCU	*	SEID2	UTCU	UTCU 1

HRMI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
DATA	HRMI	PCM	*	STAGS	PCM	*
CLOCK	HRMI	PCM	*	STAGS	PCM	*

TABLE 5-2: PDSS/IMC INTERFACE DEFINITION
(CONTINUED)

POWER	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
+5V	PWR	AO	*	SEID2	FI	113
+15V	PWR	AO	*	SEID2	FI	115
-15V	PWR	AO	*	SEID2	FI	116
TEMP	PWR	AO	*	SEID2	FI	119
+5V	A/D	AI	1	3112	AO	N11A0
+15V	A/D	AI	2	3112	AO	N11A1
-15V	A/D	AI	3	3112	AO	N11A2
TEMP	A/D	AI	4	3112	AO	N11A3
PWR ON	PWR	DI	*	SEID2	DO	60
PWR OFF	PWR	DI	*	SEID2	DO	61

5.4 DRIRU-II INTERFACE MODEL

PDSS/IMC will provide a simulated DRIRU-II interface that meets the DRIRU-II interface design as defined in the Detail Specification for DRIRU-II (MSFC-SPEC-565).

The DRIRU-II is a high performance, three axis, strap down intertial reference unit based on the use of two axis, tuned-rotor, non-floated ("dry") Gyros. DRIRU-II provides three axes of analog data and digital increment angle information.

The PDSS/IMC DRIRU model will provide for the simulation of the following interfaces:

12	Pulses	Incremental Angle Pulses
12	Discrete Outputs	Range Status telemetry Output
6	Analog Outputs	Analog Rate Telemetry Output
3	Switch Resistors	Gyro Temperatures
12	Flexible Inputs (DI's)	Electrical Interface Mode Commands
3	Analog Outputs	Motor Current Telemetry Output

On PDSS/IMC start up, the DRIRU model will initialize its measurements as specified in Table 5-3.

TABLE 5-3: DRIRU MODEL STARTUP STATE

Measurement	Initial Value	
Pulses (12)	0	No pulse output
Discrete Outputs (12)	0	Range Status = High
Analog Outputs (6)	0.0V	Analog Rate = 0.0V
Analog Outputs (3)	0.0V	Gyro Motor Current

The DRIRU model will monitor the 12 Flexible Inputs (Electrical Interface Mode Commands) once per second. Upon detection of a mode low rate command or mode high rate command input, the Range Status Telemetry output discrete outputs will be set. Table 5-4 defines the logic to be performed to output Range Status Telemetry.

TABLE 5-4: DRIRU RST OUTPUT

MODE COMMANDS "=1"	RANGE STATUS TELEMETRY (RST) OUTPUT X1A	X1B	Y1B	Y1C	Z1A	Z1C
RRH1A	0				0	
RRH2A	0				0	
RRL1A	1				1	
RRL2A	1				1	
RRH1B		0	0			
RRH2B		0	0			
RRL1B		1	1			
RRL2B		1	1			
RRH1C				0		0
RRH2C				0		0
RRL1C				1		1
RRL2C				1		1

The Analog Rate Telemetry Output commands (ANRXA, ..., ANRZC) will remain fixed unless changed by the operator or by a Timed Measurement Command.

The three temperature sensors (TEMPA, TEMPB, TEMPC) will remain fixed until the operator changes one of the front panel switches.

DRIRU Model Incremental Angle Pulses will remain zero (0) until a start command is received from the operator. Upon receipt of the DRIRU Model start, the model will output a standard set of pulses. The operator will have the capability to change the pulses by operator command or by Timed Measurement command. The standard (default) Incremental Angle Pulses will be as defined in Table 5-5. The Gyros interface will be loaded such that all six channels will be operational simultaneously. Upon completion of a total cycle (6 channels pulsed in both + and - direction) the pulse cycle will be repeated.

TABLE 5-5: DEFAULT INCREMENTAL ANGLE PULSES

MEASUREMENT	COUNT	RATE	SIGN
DTXA	200	16p/sec	+
DTXA	100	16p/sec	-
DTXB	100	32p/sec	+
DTXB	200	32p/sec	-
DTYB	10,500	1028p/sec	+
DTYB	10,500	1028p/sec	-
DTYC	20,000	2048p/sec	+
DTYC	18,000	1024p/sec	-
DTZA	5,000	16p/sec	+
DTZA	5,000	32p/sec	-
DTZC	30,000	4096p/sec	+
DTZC	15,000	4096p/sec	-

5.5 ASTROS INTERFACE MODEL

PDSS/IMC will provide a simulated ASTROS interface that meets the ASTROS interface design as defined in the Detail Specification for ASTROS (ES513218)and as illustrated in Figure 5-12.

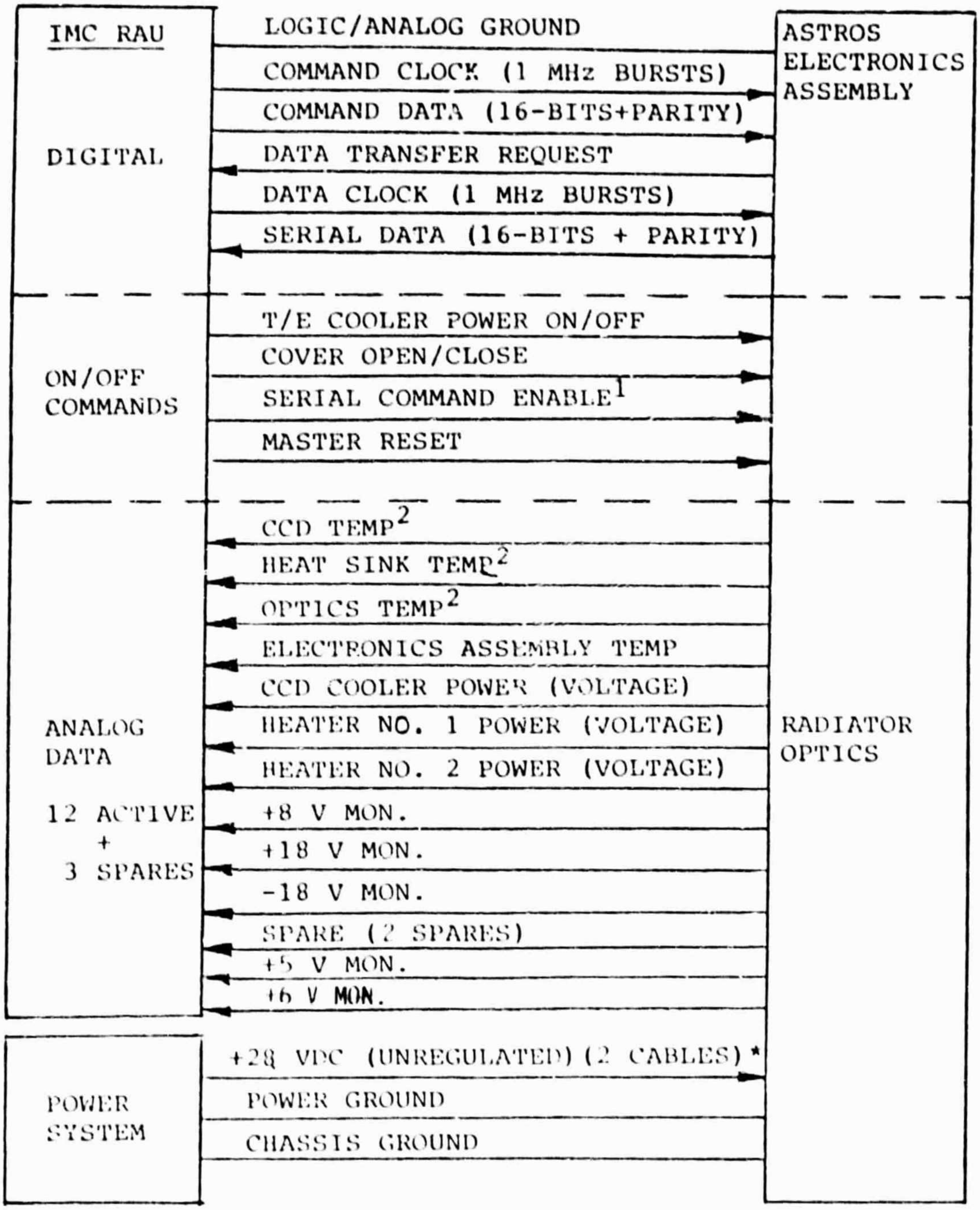
ASTROS is an electro-optical instrument which uses a Charge Couple Device (CCD) to search for, acquire, and track a group of one to three stars. Once a group of stars is acquired, ASTROS will provide highly accurate position information on the entire group, following the stars as they move through the field of view.

The ASTROS model will provide interface simulation for the ASTROS analog voltages defined in Table 5-6. The voltage levels will remain constant unless modified by the operator or by the Timed Measurement Command.

TABLE 5-6: ASTROS MODEL ANALOG VOLTAGES

TYPE = AO, DEVICE = 3112

MEASUREMENT FUNCTION	RATE	RANGE	SCALE	NOMINAL
CCD Temperature	1/10S	-65°C, -45°C	.17V/°C	-50°C
Heat Sink Temperature	1/10S	+10°C, +30°C	.13V/°C	+20°C
Optics Temperature	1/10S	+10°C, +30°C	.17V/°C	+20°C
EA Temperature	1/10S	- 5°C, +45°C	.05V/°C	+40°C
CCD Cool Voltage	1/2S	0V, +5.08V	1.0V/V	5V
Heat #1 Power	1/2S	0V, +5.08V	1.0V/V	5V
Heat #2 Power	1/2S	0V, +5.08V	1.0V/V	5V
Master Clock Status	1/1S	ON, OFF		
+5V	1/1S	+5V ± .25V	.60V/V	+5V
+6V	1/1S	+5.5V ± 0.55V	.55V/V	+5.5V
+8V	1/1S	+8V ± 1.0V	.38V/V	+8V
+18v	1/1S	+18V ± 1.0V	.17V/V	+18V
-18v	1/1S	-18V ± 1.0V	.17V/V	-18v



*1 POWER CABLE TO ELECTRONICS AND 1 POWER CABLE TO HEATERS.

NOTE 1 - MSFC MENTIONED REMOVAL OF THIS LINE.

NOTE 2 - SCALE FACTORS DEFINED IN DETAILED SPEC #ES513218.

FIGURE 5-12: ASTROS INTERFACE SIGNALS

The ASTROS model will provide interface simulation for the following ASTROS ON/OFF commands (See Table 5-7). These inputs to ASTROS will be sampled once per second.

TABLE 5-7: ASTROS MODEL DISCRETE INPUTS

TYPE	DEVICE	MEASUREMENT FUNCTION
FI	SEID	Thermoelectric cooler power on/off
FI	SEID	Baffle cover open/close
FI	SEID	Master Reset

The state (ON/OFF) of the Thermoelectric cooler power will be set in the serial Data Status Word (TEC).

The state of the baffle cover open/close will be set in the serial Data Status Word (CVR). Change of states of the baffle cover open/close will be processed identical to the serial cover open/close command.

On detection of the Master Reset ON state, the ASTROS model will simulate a power on condition. The model will perform the following:

- Enter Standby mode
- Set Defect map Reset
- Set Thermoelectric cooler power ON/OFF status to state of Thermoelectric cooler power ON/OFF command.
- Set Baffle cover open/close status to state of Baffle cover open/close ON/OFF command.
- Set Self-test LED to OFF.
- Set Light FLOOD to ON.

The ASTROS model will simulate the ASTROS serial RAU interfaces including a simulation for the tracker modes and command and data handling systems. The ASTROS model will simulate the four operating modes (acquisition, track, defect map, and standby) for the tracker, the ASTROS RAU command and status handling, and the ASTROS commands. Figures 5-13 to 5-15 define the ASTROS commands and status.

Command Format:

```
Word 1:    15   12 11    8 7             0
          |  F   |    0   | Command Code |

Word 2-5:    15                          0
            |   Command Parameters       |
```

COMMAND TABLE

COMMAND	COMMAND CODE BIT NO. 7	6	5	4	3	2	1	0	COMMAND PARAMETERS
Standby	0	0	0	0	0	0	0	1	None-Note 1
Frame Search Acquisition	0	0	0	0	0	0	1	0	None
Preselected-Star Acquire	0	0	0	0	0	0	1	1	Note 2
Defect Map	0	0	0	0	0	1	0	0	None
Reset Defect Map	0	0	0	0	0	1	0	1	None
Specify Updata Interval	0	0	0	1	0	0	0	0	Note 3
Memory Dump	0	0	1	0	0	0	0	0	Note 4
Self Test LED On	0	1	0	0	0	0	0	0	None
Self Test LED Off	0	1	0	0	0	0	0	1	None
Cover Open	1	0	0	0	0	0	0	0	None
Cover Close	1	0	0	0	0	0	0	1	None
Light Flood ON	0	0	0	0	1	0	0	0	None
Light flood OFF	0	0	0	0	1	0	0	1	None

FIGURE 5-13: ASTROS COMMAND FORMAT

NOTES:

1. When additional parameters are not required for a command, the extra words of the fixed 5-word format are ignored by ASTROS.

2. The Command Parameters are defined as follows:

Words 2-4:

15 — 8	7 — 0
L_i	P_i

Words 5:

15	14 — 10	9 — 5	4 — 0
	MV_1	MV_2	MV_3

Where: L_i, P_i are the predicted line and pixel coordinates for the ith star, divided by 2($0 \leq L_i \leq 255$, $0 \leq P_i \leq 159$)

MV_1 are the approximate visual magnitudes of the preselected star in the format XXX.XX ($0 \leq MV_i \leq 7\ 3/4$)

3. Word #2 has the format

	7 — 0
	I_C

Where: I_C is the commanded update interval (multiple of 16 ms)

4. Word #2 has the format

15 — 0
A_1

Where: A_1 is the 16-bit address of the first word of memory to be read

FIGURE 5-13: ASTROS COMMAND FORMAT (CONTINUED)

STATUS WORD = FIRST WORD OF EACH DATA OUTPUT:

15 7	6	5	4	3	2 0
I	MD	ST	CVR	TEC	R	MODE

ABBREVIATIONS	TITLE	POSSIBLE VALUES:
Mode	Operating Mode	0-Frame Search Acquisition 1-Preselected Star Acquisition 2-Track 3-Defect Map 4-Standby
R	Rate Flag	0-Normal Operation 1-Requested Update Interval Will Degrade Performance
TEC	Thermoelectric Cooler Power	0-OFF 1-ON
CVR	Cover Status	0-Closed 1-Open
ST	Self-Test Star	0-OFF 1-ON
MD	Memory Data	0-Normal Operation 1-Subsequent 9 Words Are Memory Data
I	Approximate Interval Between Updates	= I x 16ms

FIGURE 5-14: DATA STATUS WORD FORMAT

Word #

2

15	14 — 10	9 — 5	4 — 0
L	B_3	B_2	B_1

3

15 — 10	0
(Spare)	T

4

v_1

5

h_1

6

v_2

7

h_2

8

v_3

9

h_3

10

15 — 11	10 9	8 7	6 5	4 3	2 1	0
(Space)	V_1	H_1	V_2	H_2	V_3	H_3

FIGURE 5-15: TRACK MODE DATA FORMAT

Abreviation	Title	Possible Values
B_i	Brightness of ith star	= 0 = invalid star, otherwise $= \frac{\text{(pixel intensity-threshold)}}{\text{Scaling factor}}$
L	Light flood Status	0-OFF 1-ON
T	Integration	= T x 2ms
v_i, h_i	Coordinates of ith star stay	16 LSBs of the vertical and horizontal coordinates of the ith star relative to the CCD frame: corrected for optical distortion and (possibly) interpolator nonlinearity.
V_i, H_i	MSBs of ith stay	Two MSBs (bits 16 and 17) of the vertical and horizontal coordinates of the ith star position

FIGURE 5-15: TRACK MODE DATA FORMAT (CONTINUED)

The ASTROS Model will simulate the logic interface to accept commands consisting of five (5) digital (16 bit + parity) words. The ASTROS Model will provide a simulated response interface to the digital commands.

For the ASTROS Modes, the following data (see Table 5-8) will be output by the ASTROS Model. The rates and output data will be settable by the operator.

TABLE 5-8: ASTROS MODEL SERIAL DATA OUTPUT

MODE	RATE	OUTPUT
ACQUISITION	1/sec*	See Figure 5-15 for Format
TRACK	10	See Figure 5-15 for Format
		L = OFF
		B_3 = 8
		B_2 = 16
		B_1 = 4
		T = .5 + .05 = .55
		v_1h_1 = 0C00,1000 or INC**
		v_2h_2 = 4000,4000 or INC
		v_3h_3 = 2000,0F00 or INC
		V_1H_1 = 00,00
		V_2H_2 = 10,10 or INC
		V_3H_3 = 01,01
DEFLECT MAP	1/sec*	See Figure 5-15 for Format
STANDBY	1/sec*	See Figure 5-15 for Format

* The rate will be specifiable by the operator and will range from 200 milliseconds to 5 seconds.

** The INC function is an incrementing data field starting with 0000,0001,...

Responses to serial commands will be driven by an ASTROS model data base that facilitates operator control of responses and data. The ASTROS model data base will allow the user to introduce ASTROS failure modes.

For the serial commands the following operands will be updatable by the operator:

MODE	Operating Mode
R	Rate Flag
TEC	Thermoelectric Cooler Power
CVR	Cover Status
ST	Self Test Star
MD	Memory Data
IO	Update Rate
T	Response Time

The ASTROS Model will simulate the ASTROS Self Test operation. On Acquisition requests, the ASTROS Model will determine whether the baffle cover is Open or Closed. If closed, the self test LED will be tested. If ON, ASTROS Model will return with a single star acquisition. If OFF, ASTROS will return with no star acquisition.

The ASTROS related Experiment Application Software and Display page simulation will support the health test alarm status from IMCE. Four alarm status conditions have been identified.

The ASTROS model logic is defined by the following program logic. The model logic will be structured to operate in a "nominal" path mode. Error conditions will be induced by operator commands.

START FRAME SEARCH ACQUISITION (CMD=2)	
STEP 1	PROCESS
1.	SET MODE TO FRAME-SEARCH-ACQUISITION
2.	DELAY 10 SECS
3.	FETCH ACQUIRE 3 STARS
4.	IF AT LEAST 1 STAR
	THEN:
5.	SET MODE TO TRACK
6.	SET UPDATE INTERVAL IO = 1000ms
	ELSE:
7.	SET MODE TO STANDBY
	END
8.	SET RATE FLAG OFF

START PRESELECTED GUIDE STAR ACQUISITION (CMD=3)	
STEP	PROCESS
1.	SET MODE TO PRESELECTED-STAR-ACQUIRE
2.	PERFORM STORE CCD COORDINATES
3.	DELAY 10 SECONDS
4.	FETCH ACQUIRE STAR
5.	IF STAR ACQUIRE
	THEN:
6.	SET MODE TO TRACK
7.	SET UPDATE INTERVAL IO - 1000ms
	ELSE:
8.	SET MODE TO STANDBY
	END
9.	SET RATE FLAG OFF

DEFLECT MAP (CMD = 4)	
STEP	PROCESS
1.	SET MODE TO STANDBY
2.	DELAY 3 SECONDS
3.	SET MODE TO STANDBY

RESET DEFECT MAP (CMD = 5)	
STEP	PROCESS
1.	SET MODE TO STANDBY
2.	DELAY 1 SECOND

SPECIFY UPDATE INTERVAL (CMD = 16)	
STEP	PROCESS
1.	IF MODE = TRACK THEN EXIT
2.	IF NEW IO < 10
	THEN:
3.	SET RATE FLAG ON
	END
4.	SET IO TO NEW IO

MEMORY DUMP (CMD = 32)	
STEP	PROCESS
1.	SET MODE TO STANDBY
2.	PERFORM COMPUTATION 9 DUMP WORDS
	Wi = ADDR + i0i0 where i = 1 TO 9

SELF TEST LED ON (CMD = 64)	
STEP	PROCESS
1.	SET SELF TEST LED ON

SELF TEST LED OFF (CMD = 65)	
STEP	PROCESS
1.	SET SELF TEST LED OFF

COVER OPEN (CMD = 128)	
STEP	PROCESS
1.	SET MODE TO STANDBY
2.	SET COVER STATUS TO OPEN

COVER CLOSE (CMD = 129)	
STEP	PROCESS
1.	SET MODE TO STANDBY
2.	SET COVER STATUS TO CLOSE

LIGHT FLOOD ON (CMD = 8)	
STEP	PROCESS
1.	SET LIGHT FLOOD STATUS ON

LIGHT FLOOD OFF (CMD = 9)	
STEP	PROCESS
1.	SET LIGHT FLOOD STATUS OFF

ILLEGAL COMMAND	
STEP	PROCESS
1.	SET MODE TO STANDBY

5.6 UIT INTERFACE MODULE

PDSS/IMC will provide a simulated UIT interface that meets the ultraviolet Imaging Telescope (UIT) interface as defined in the UIT Instrument Interface Agreement (JA-300).

The IMCE data will be transmitted to UIT model in the form of a serial command.

The UIT Model interface will be as defined in Table 5-9.

TABLE 5-9: UIT MODEL INTERFACE

TYPE	DEVICE	RATE	STRUCTURE	CONTENTS
SI	RIUI	50HZ	2-16Bit Words	Pitch & Yaw Axis Error Signals
AO	3112	50HZ	10Bit Analog	Pitch & Yaw Difference Signals

The UIT model will receive two serial messages at a maximum rate of 20 milliseconds. The serial enable shall go false at the end of each serial message. The UIT model shall also output (50HZ) two Analog Outputs containing pitch and yaw differences respectively.

The serial messages shall contain the digitized pitch and yaw axis error signals that will drive the UIT IMC system. Each axis signal shall be represented by a 13 bit binary magnitude and a 1 bit sign within a 16 bit message which shall be formatted as follows for both the pitch and yaw error.

bit:	0							7	8						15
	SIGN	MSB											LSB		

PITCH ERROR
YAW ERROR

The UIT data word is 13 bits of two's complemented data.

Maximum + Pitch or + Yaw error shall be 7FFC hex

Maximum - Pitch or - Yaw error shall be FFFC hex

Zero shall be 0000 or 8000 hex.

The arcsecond error band shall be digitized linearly over the 13 bit magnitude range.

Error signal shall represent the deviations in pitch and yaw of the principle axis of the cruciform from the line-of-sight within the specified band width. The PDSS/IMC UIT model will acquire 50 sets of pitch and yaw error data (2 16 bit data words) per second. The data will be displayable on the UIT Display page. No processing of UIT data will be performed. The PDSS/IMC UIT model will retain the most current 50 serial messages for pitch and yaw on the PDSS/IMC data bus.

PDSS/IMC will return the ptich and yaw error signals in analog format on the analog output channels.

5.7 WUPPE INTERFACE MODULE

PDSS/IMC will provide a simulated WUPPE interface that meets the Wisconsin Ultraviolet Photo-Polarimeter (WUPPE) interface as defined in the WUPPE Instrument Interface Agreement (JA-299).

The IMC data will be transmitted to the WUPPE model in the form of a serial command.

The WUPPE Model interface will be as defined in the Table 5-10.

TABLE 5-10: WUPPE MODEL INTERFACE

TYPE	DEVICE	RATE	STRUCTURE	CONTENTS
SI	RIUI	50HZ	1-16 Bit Word	Pitch & Yaw Axis Error Signal

The WUPPE model will receive one serial message at a maximum rate of 20 milliseconds. The serial enable shall go false at the end of each serial message.

Each serial message shall contain the digitized pitch and yaw axis error signals that will drive the WUPPE IMC system. Each axis signal shall be represented by a 7 bit binary magnitude and a 1 bit sign within a 16 bit message which shall be formatted as follows:

bit:	0							7	8							15
	SIGN	MSB						LSB	SIGN	MSB						LSB

PITCH ERROR
YAW ERROR

Maximum + Pitch or + Yaw error shall be 7F hex

Maximum - Pitch or - Yaw error shall be FF hex

Zero error shall be 80 or 00 hex.

The ± 10 arcsecond error band shall be digitized linearly over the 7 bit magnitude range.

Error signal shall represent the deviations in pitch and yaw of the principal axis of the cruciform from the line of sight within the specified band width.

The PDSS/IMC WUPPE model will acquire 50 sets of pitch and yaw error data (1 16 bit data word) per second. The data will be displayable on the WUPPE display page. No processing of WUPPE data will be performed. The PDSS/IMC WUPPE model will retain the most current 50 serial messages (16 bits) in the PDSS/IMC data base.

PDSS/IMC will return the pitch and yaw error signals in analog format on the analog output channels.

5.8 POWER SUBSYSTEM

The PDSS/IMC Power Subsystem model will provide the following interfaces:

1. Acquire 4 power signals 1/second via SEID FI's

   +5v
   +15v
   -15v
   TEMP

2. Output 4 corresponding power signals via CAMAC 3112 AO

   +5v
   +15v
   -15v
   TEMP

   These signals will be set to the corresponding acquired power signal values.

3. Provide Power ON/OFF Discrete Outputs (via SEID).
   The operator will have the capability to command power ON/OFF.

5.9 IMCE STRAWMAN FUNCTIONS

The following sequence of events represent a "typical" IMCE operational sequence.

1. Crew sends power-on CMDS to IMCE, AST, and DRIRU.
2. PCC and DEP perform self-tests, status sent to crew if fail.
3. PCC exercises an initialization table (with appropriate warm-up waits).
   a. TMI (Set GMT, Begin UTC 1024 KHZ and 4 HZ services)
   b. AST CMD to standby with cover closed
   c. ASTRO CMD to appropriate mode
   d. UIT/WUPPE outputs inhibited
   e. Move data base from MMU to DEP, DEP performs sumcheck
   f. Other functions as required
4. Crew selects OSP/AST configuration and sends to PCC. (Default is AST)
5. PCC Begins Telemetry and Analog to RAU TASK. (If mode is OSP, PCC Begins OSP/RAU TASK).
6. PCC enters standby mode.
7. Crew sends Operate/Acquisition CMD to PCC.
8. PCC sends appropriate CMDS to AST
9. PCC Begins GYRO Read TASK.
10. AST on target to PCC.
11. PCC Begins AST/DRIRU Data to DEP TASK.
12. DEP Begins Processing ERROR signal for UIT/WUPPE.
13. When Kalman Filter settling time has elapsed, PCC enables UIT/WUPPE DEI interface and Begins data to UIT/WUPPE.
14. PCC Begins UIT fast rate analog data to HRM TASK.

NOTE: IMCE Continues in this state until a mode command is sent by the crew. Step 7 could have been in response to a calibrate mode command from the crew.

6.0 PDSS/IMC UTILITY SOFTWARE

The PDSS/IMC system will provide utility software to perform the following functions:

1. Generate Display Information Files
2. Merge and List Timed Sequence Commands
3. Generate Master Measurement Data Base
4. Generate and Maintain PDSS/IMC Data Base

The general characteristics for the utility programs are defined below.

6.1 Display Information File Utility

The Display Information File Utility will accept an user defined Display Information Definition file and will generate a Display Information File.

The Display Information Definition file will be generated by standard DEC Text Editor. This file will contain the following type information:

1. Header
2. Subtitles
3. Measurement ID's
4. Display Coordinates

The Display Information File Utility will take the Display Information Definition File and will generate the Display Information File that will be used by PDSS/IMC during real time operations.

6.2 Master Measurement Data Base Generate Utility

The Master Measurement Data Base (MMDB) Generate Utility will generate an MMDB file from a Definition File built by standard DEC Text Editor. The Definition File will be in a format compatible with the POCC Data Base Definition.

6.3 PDSS/IMC Data Base Utility

PDSS/IMC Data Base Utility will be provided to generate and maintain the PDSS/IMC Data Base.

This data base contains the following:

- Definition of PDSS/IMC Current Values Tables
- Definition of Measurement Comparator Table
- Definition of Model's Default Values
- Definition of Model's Logic Tables

These data tables will be defined and utilized in such a manner to facilitate the data basing of that data.

6.4 Timed Sequence Command Utility

The Times Sequence Command Utility will accept multiple files built by standard DEC Text Editors.

The utility will output a listing that includes:

- Commands (Generic and Preprocessed)
- Time
- File Source

The output listing will be Time Sequenced.

The Timed Sequence Command Utility will generate a Single Timed Sequence Command File.

7.0 PDSS/IMC POST PROCESSING SOFTWARE

The PDSS/IMC Computer Interface Simulation logging function will have the capability to log the following data.

1. Command Messages from PDSS/IMC to IMCE
2. Response Messages from IMCE to PDSS/IMC
3. Operator directed comments
4. PDSS/IMC Verification generated data
5. PDSS/IMC Current data values

The post processing software will provide the capability to process the PDSS/IMC log output. The post processing software reports will be directed to the line printer. The computer interface log file consists of current values of GMT time, AI's, AO's, DI's, DO's, SI's and SO's, written in fixed block files at intervals ranging from 1 second to 100 seconds. The following capabilities will be provided for processing log file data.

Time will be printed as Julian time (days: hours: minutes: seconds: milliseconds).

Signals textual names will be provided from the Measurement Data File.

Discrete data will be converted to ON or OFF.

Analog data will be converted to decimal representation (volts) or engineering unit values as indicated by the Measurement Data File.

Serial data will be printed as ASCII hex data in a hhhh,hhhh,.... format.

The following options will be provided to the user for selecting portions of the log for printing.

- The user can print only data within a specified time window.

- The user can print the first block of data and subsequently print time and data only when there is a change in the data.

- The user can print data only when the data meets a condition.

    - Print only DO's that are ON (or OFF)
    - Print "Message x" when DO X is on.
    - Print only AO's that have a value greater than x.
    - Print "Message y" when a certain analog exceeds value x.

The Qual Test Log function will provide the capability to log messages exchanged between PDSS/IMC and the IMCE flight processor. All messages will be logged in binary format.

The acknowledge messages will not be logged.

Messages will not be time-tagged. The user can use the READ GMT command for tracking time.

Messages from PDSS/IMC will be logged.

Messages from IMCE will be logged.

Operator messages will be logged.

When an End of Medium is sensed on the log disk, the logging function will be terminated, the log file closed, and the operator informed.

8.0 PDSS/IMC ACCEPTANCE CRITERIA

PDSS/IMC will be utilized as an integral part of the system verification process. As such, PDSS/IMC must provide the following basic services:

- Command and Monitor capability to IMCE primarily via the flight interfaces - SEID and PDSS/IMC hardware
- Central recording system - STAGS
- Self-Test capability
- Qualification Testing - PDSS/IMCE Qual Test package

The PDSS/IMC Acceptance criteria will be based on the successful operation of each of the following capabilities, functions, or commands. A detailed Acceptance procedure will be defined.

8.1 System Integration

1. The system cabling will be verified to be correct.

2. The system components will be verified to be in an operational state. (LSI 11/23, DSD 880, Printer, CRT/Keyboard, Video Display Unit, CAMAC Crate, RAUI, RIUI, GYROS, A03112, and SEID.)

3. The system power up and power down procedures will be verified to be correct.

4. Each measurement will be verified for proper cabling and commandability.

8.2 PDSS/IMC Qualification Test

1. The PDSS/IMC QT IMCE commands will be demonstrated and verified.

2. The PDSS/IMC QT system commands will be demonstrated and verified.

3. The PDSS/IMC QT Sequence capability will be demonstrated and verified. This includes the capability to Pause, Single Step, and Resume Sequences. Entry of operator keyboard commands during sequence operation will be demonstrated and verified.

4. The PDSS/IMC QT Sequence File capability will be demonstrated and verified. This includes the capability to enter IMCE commands, PDSS/IMC system commands, comment lines and continuation lines.

5. The PDSS/IMC QT Logging function will be demonstrated and verified. This includes the capability to activate and deactivate the logging function and the post processing of the QT Log file.

6. The PDSS/IMC QT displays will be demonstrated and verified.

8.3 Computer Interface Software (CIS)

1. The PDSS/IMC CIS system commands will be demonstrated and verified.

2. The PDSS/IMC CIS power up procedures and states will be demonstrated and verified.

3. The PDSS/IMC CIS models will be demonstrated and verified. This includes the simulation logic for each model, the independent operation of each model, and the integrated operation of models.

4. The PDSS/IMC CIS Timed Measurement Command capability will be demonstrated and verified. This includes the preprocessor program to merge Time measurement Command files.

5. The PDSS/IMC CIS preprocessor program to generate Display Information Files will be demonstrated and verified.

6. The PDSS/IMC CIS preprocessor program to generate the Master Measurement Data Base will be demonstrated and verified.

7. The PDSS/IMC CIS logging function will be demonstrated and verified. This includes the capability to activate or deactivate the logging function and the post processing of the PDSS/IMC CIS Log File.

8. The PDSS/IMC CIS displays will be demonstrated and verified.

9. The PDSS/IMC Experiment Application Software for the IMCE Experiment computer Display simulation will be demonstrated and verified.